

PC MAGAZINE

Head to Head in PC Labs

- 76 17-Inch and 19-Inch Monitors
- 27 XML Browsers, Tools, and More
- 3 IP Paths to Lower Phone Bills

Plus: The 100 Best CD-ROMs



FIRST LOOKS:

- 450-MHz Desktops
- 300-MHz Notebooks
- First DVD-RAM Kit
- USB Digital Cameras
- AOL Version 4.0
- Network Ink Jets
- E-Mail Porn Blocker

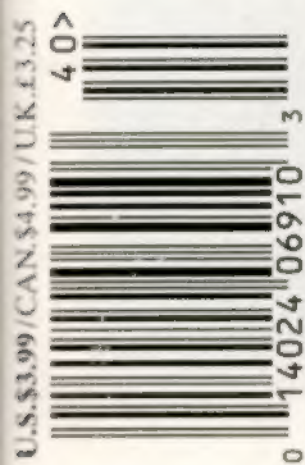
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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 17 OCTOBER 6, 1998

THE YEAR

**What You Need to Do to Protect Yourself
From the Millennium Bug**

2000 CRISIS



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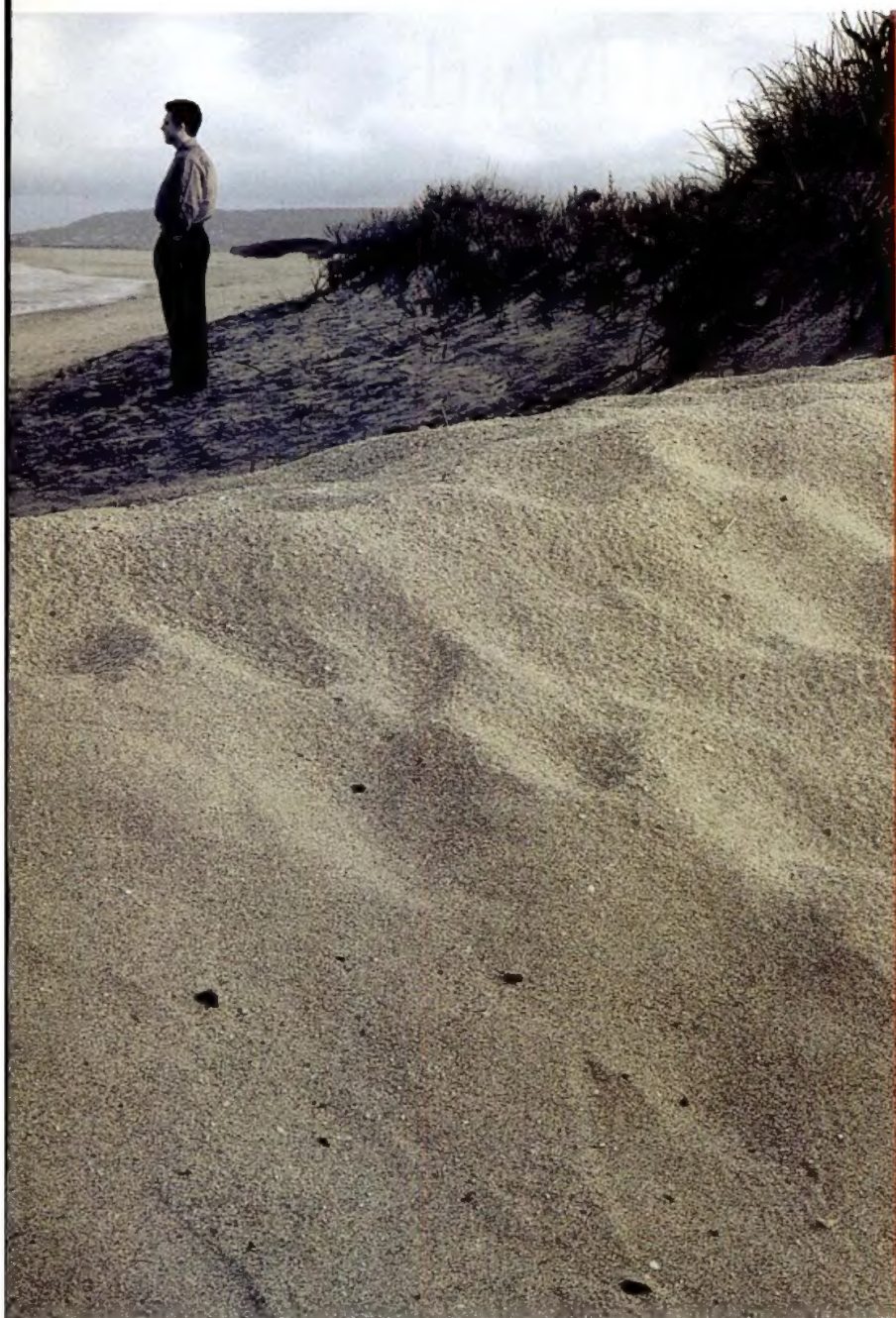
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N E T W A R E 5

Y2K: Reality and Myth



The buzz about the year 2000 (Y2K) problem is fast becoming an important public issue. In our September 1 issue, I talked about why I think the Y2K problem is something each of us needs to work on, and listed some steps. In this issue, we expand on those steps to give you guidelines for gaining control of any Y2K

people think that everything electronic will stop working forever that morning. This won't happen. Large businesses are well aware of the problem and have every incentive to fix the big problems before then. Some are replacing older systems with new ones. And most are planning to fix programs when necessary, sometimes by just reinterpreting the two-digit date to a rolling 100-

issues you or your company may face. Although the Y2K problem is real, much of what I hear and read is filled with myths and misconceptions. Following is my top-five list of myths.

Myth 1: The year 2000 problem affects only mainframes. I wish that were true, but it's not; PCs have the Y2K problem as well. In fact, the problem has nothing to do with type of computer—only with programmers' desire to store dates in two digits instead of four. All those who did this understood the potential problems, but most didn't expect their programs to be used through 2000.

People talk about 200 million lines of COBOL needing to be checked and fixed, and that may be right. But the BIOSs in many older PCs have the same problem, as do many versions of PC software. Even "compliant" applications can have problems if you use two-digit dates in a macro or a calculation. In the meantime, we've created a Web site—www.pcmag.com/y2k—that gathers information on it.

Myth 2: The problem will occur at midnight on 1/1/00. If only it were that simple! Actually, some of the problems started to occur years ago. For instance, some merchants ran into credit card systems that didn't accept cards with an expiration date ending in 00. That problem has pretty much been fixed, but it's indicative of the kinds of things we should watch out for. Others are sure to come. Many Y2K-compatible programs still have a two-digit range that extends only into the 2020s or 2040s.

Some problems will occur even earlier. September 9, 1999, is a date that many people worry about, because some programmers used 9/9/99 to indicate an invalid date field. Others worry about the 99th day of 1999 (April 9, 1999).

Myth 3: The world as we know it will end on 1/1/00. Some

year window, which will work for now. Many smaller businesses aren't taking an aggressive approach, believing they aren't all that dependent on computer systems. Let's hope they are right.

Myth 4: The problems are well known. Even though the basic Y2K problem is well understood, the difficulty is in finding all the places where dates show up. Two-digit date codes were used in all kinds of programs on all kinds of systems. Many of the programs were written years ago, and no one remembers all aspects of them. It is impossible for programmers to find every such system in the next year and a half. Some problems will be minor; some will be more serious. I expect we'll get through them, but not without some pain.

Myth 5: Y2K is a technical problem. Certainly there are technical problems that must be addressed, but the legal, public relations, and political issues are just as important.

On the legal front, some claim that software developers should be legally responsible for making sure every version of software ever sold is Y2K-ready. Politically, my biggest concern is with government computers. Politicians don't want to spend money on something that is as invisible as fixing lines of code.

PR-wise, I expect you'll start seeing a lot more scare stories about how planes will fall from the sky and power will fail everywhere because of the Y2K problem. My guess is that on the actual day there will be a few problems, particularly with government systems. It won't be painless, but we will get through it.

A stylized, handwritten signature of Michael J. Miller in black ink.

MICHAEL J. MILLER



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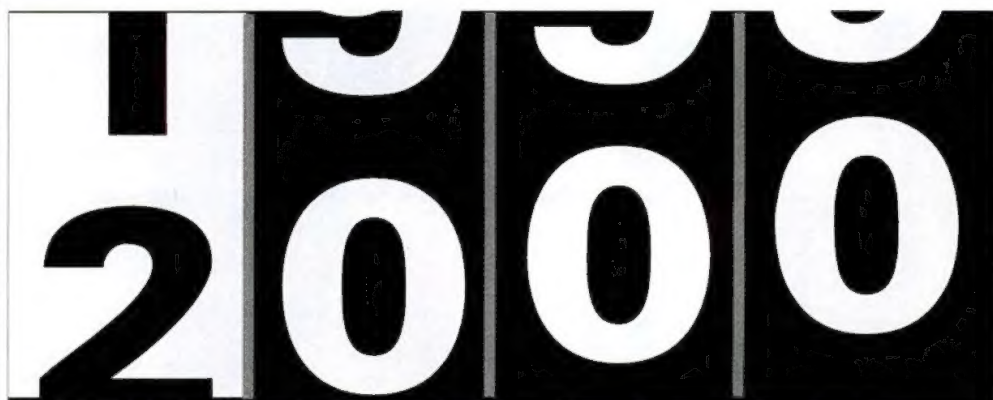
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COVER STORY

WHAT TO DO ABOUT THE YEAR



BY JIM SEYMOUR

Y2K. So simple at its core but so huge and complex in the real world. Here are 22 pages of tips and recommendations, planning guidelines, surveys of testing tools, and advice on how to fix things. There's still time to do plenty.....100

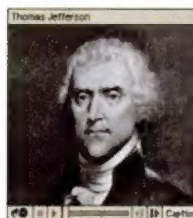
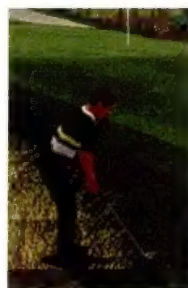
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AFTER HOURS

The Top 100 CD-ROMs

BY JENNIFER TRIVERIO
And for some relief at the end of your day, here's the fun stuff. We're seeing some first-rate nonbusiness software, and it's not all games. But it is all aimed at making you smile or helping you out. We stop once a year to sort through the hundreds of packages we see to get the list down to a mere 100 that we think sit at the top of the heap. Relax with one of these.....363

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BY JAMIE M. BSALES
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HARDWARE

17- and 19-Inch Monitors: Bigger and Better

BY ALFRED POOR

It's really time to upgrade, if you haven't yet. Prices have dropped to amazing levels in the past two years, but the quality of midsize monitors has been maintained—or improved. They're now supplanting smaller models on many business desktops. And some this size are even good enough to handle the more demanding tasks of CAD and image editing162

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INTERNET

Why XML Matters



BY BEN Z. GOTTESMAN

The next wave of computing on the Web is tied to XML—eXtensible Markup Language—which acts as a kind of super data-definition tool to help make our searches and general use of the Web go easier. Here's how it works, and some products that use it already215



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Measuring Monitors

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Plus:

- Test your PC for Y2K compliance at the Virtual Labs.



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America's Game, Online

While the world's stock markets are undergoing a shift to electronic trading systems, another lesser-known trading system is undergoing an equally revolutionary shift with sweeping implications for sports fans.

executive producer at Small World Sports, which licenses its games to CNN/SI, Fox Sports, Yahoo!, and other sites. According to research firm Cyber-Dialogue, 33 percent of an Internet population of 58 million U.S. adults visit sports-related sites.



Fantasy sports games, in which mature adult males pretend to operate their very own professional sports franchises, are turning out to be cash cows for Web sites, with some sites reportedly getting millions of hits a day from devotees. In a fantasy sports game, you get to draft your own dream team of real-life athletes, trade players, move them onto the field, and bench them. Fantasy points are based on the homers, strikes, runs, touchdowns, field

What's the attraction? In much the same way that an online investor tracks his portfolio, you—as general manager and coach of your team—get to track and analyze detailed stats of your players and team performances. "People follow fantasy sports much like they follow a stock portfolio, constantly looking for ways to strategize and better their position," says Brett Krasnove, producer at Small World Sports.

Now that free games

from sites such as Small World Sports and Yahoo! are plentiful, will fantasy fans pay to play? "People will pay for this content," says Patrick Keane, an analyst at Jupiter Communications. "Most people won't pay for content online, because the Web is so flush with free content. But fantasy sports are so unique, and people know that it's hard to manage yourself," he says. ESPN's Geoff Reiss agrees. "Games are dependent on other people in your league taking the games seriously. If they don't, it's like to trying to play tennis by yourself. It's just not a lot of fun."

Fantasy Sports Leagues

These are just a few of the Web sites offering fantasy sports games.

Small World Sports	www.sportstake.com
ESPN SportsZone	www.espn.com
Fox Sports	www.foxsports.com
The Score	www.thescore.com
Small World Sports	www.sports.smallworld.com
The Sporting News	www.sportingnews.com
Yahoo! Sports	fantasy.yahoo.com/sfi

goals, fumbles, interceptions, and other events during actual games.

The concept is a natural one for the Web, which provides a community where sports fans can gather, the computing know-how to crunch statistics, and good demographics for advertisers—a high concentration of young, reasonably affluent, and loyal males. "Participants crave involvement no matter where they are—work, home, or school," says Geoff Reiss, senior VP at ESPN/SportsZone.

"There's no limit to the degree that American males are interested in sports," says Erik Barmack,

Who's Worried About Y2K?

of respondents to a recent PC Magazine

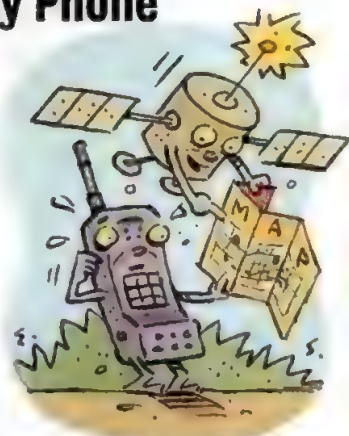
Online poll told us that they're worried about the year 2000 bug, but another 34 percent said they're not worried at all. 39 percent told us that they're "somewhat" worried.



Find Your Way by Phone

New horizons are opening up for GPS (global positioning system) technology, following the announcement by Santa Clara-based Sirf Technology that it has developed a tiny GPS chip set that fits inside a cellular phone. Ericsson and Nokia have announced plans to use the chip set in their cellular phones, and Acer and Umax plan to use it in upcoming consumer electronics devices.

Current GPS devices, such as the receivers that plug into notebook computers, work by communicating with satellites to pinpoint the location of the receiver on a map. But devices smaller than notebook computers haven't seen much adoption of GPS, since considerable power is required to receive the satellite signals. Sirf's inexpensive chip set fits into a cellular phone or hand-held computer



and is powerful enough to receive satellite signals.

Sirf's founder, Kanwar Chadha, says that many applications can be built around GPS once it shows up in cellular phones and hand-held computers. For instance, a GPS-enabled sales database would be able to sort information according to a salesperson's precise location.

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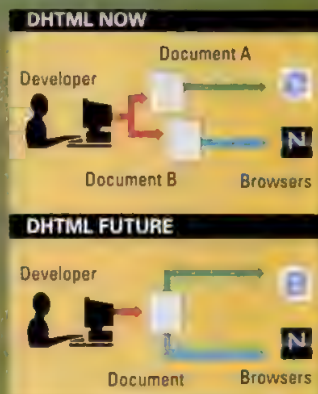
Netscape Sneak Peek

Demonstrated a new HTML layout engine for Navigator, designed to meet key new Web standards and to break up browser functionality into embeddable components. The move could largely spell the end of incompatible implementations of advanced Web technologies, such as Dynamic HTML (DHTML).

The browser's layout engine is the element that takes HTML and associated code describing a Web page's appearance and renders what the user sees. The layout engines in current versions of Microsoft Internet Explorer and Netscape Navigator are largely incompatible when presenting features beyond vanilla HTML elements such as text blocks and images. So most Web developers have eschewed using more advanced capabilities such as layering, which stacks objects in the browser window.

Netscape has pledged that its new layout engine will be compliant with the Document Object Model (DOM) specification, which the World Wide Web Consortium has ratified. Netscape also says the layout engine will support the entire CSS (Cascading Style Sheets) level 1 specification and many CSS level 2 features.

While it will be some time before the new layout engine shows up, an embeddable engine that complies with key new Web standards promises exciting possibilities for developers and Web surfers alike.



Finding Kids

Canon Computer Systems' latest advertisement doesn't promote a new Bubble Jet printer, digital camera, scanner, or any product at all, for that matter. Instead, the ad—a photo collage of 30 missing kids—is part of Canon's work

Canon



bring
missing
children
HOME
program

A special program in support of the National Center for Missing and Exploited Children

with the Center for Missing and Exploited Children to help find kids who have disappeared from home.

By donating BJC-4550 Color Bubble Jet printers, CanoScan 300 scanners, and PowerShot 350 digital cameras to police departments around the nation, Canon is helping law enforcement get flyers with kids' photos out to local communities within the first 12 (and most critical) hours after children are reported missing. Without ready access to such hardware, the process can take days rather than hours.

And the efforts are paying off. Research shows that one in seven missing children is recovered as a result of someone recognizing a photo. The Center says it gets 1.5 million hits a day to its Web site (www.missingkids.com). Canon is also gearing up to work with retailers such as Computer City and Fry's to produce instant photo IDs for kids.

Top-Selling Digital Cameras

Sony MVC-FD7 (\$617)

Kodak DC-210 (\$682)

Kodak DVC-323 (\$158)

Casio QV-TT (\$194)

Sony MVC-FD5 (\$466)

Olympus D-808L (\$1,025)

Kodak DC-120 (\$645)

Olympus D-320L (\$477)

Kodak DC-200 (\$481)

Epson PhotoPC 600 (\$457)

Source: ZD Market Intelligence.
Data for June 1998

Fighting Linkrot

According to a survey completed by researchers at the Georgia Institute of Technology, *linkrot*—when a Web page's links to other Web pages fail to take you anywhere—is one of the fastest-growing and most-despised online trends. The researchers found that 60 percent of Web users say broken links threaten the whole fabric of the Web.

The good news: Link-validation tools are arriving on the scene. NetMechanic's Link Check, for instance, scans sites for broken links. Or you can hire a service bureau to check your links for you.

The Web at 1000X

Close your eyes and try to envision what the Web could offer were it 1,000 times as fast as it is today. That's more than just wishful thinking for Joe Mambretti, director of the new Center for Advanced Internet Research, which is slated to open at Northwestern University by the end of the year.

A project of Northwestern and IBM, along with other corporate partners, the Center first plans to tackle digital video. Its upcoming TV station for the Internet will broadcast digital video over fiber-optic lines, support interactivity, and offer customized content. Connections will go to researchers and universities first, then to businesses and homes.

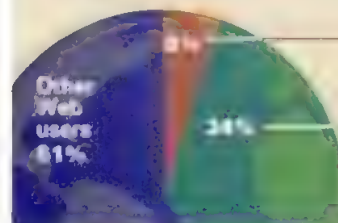
"People don't even bother to access video clips, because it's frustrating," Mambretti says. But on Abilene—a network that runs at over 2 gigabits per second—video could get to viewers 1,000 times faster. Abilene is an Internet 2 backbone run by Cisco, Nortel, Qwest, and over 125 universities. Abilene is also unique in its support of *differentiated services*, which guarantees that, for example, a radiologist needing to view an X-ray would have priority over someone requesting a price on a pair of jeans. "The current Internet is a best-effort service in which everyone is contending for the same resources," Mambretti says. "Often, this contention results in people not getting what they want when they want it."



THIS ISSUE'S CONTRIBUTORS: Carol Levin, Sebastian Rupley, Don Willmott.

Travel Bug Hits the Web

Almost 40 percent of the 41.5 million people online in the U.S. at the end of 1997 used the Web to browse for travel information or to purchase tickets. Research firm Cyber Dialogue predicts that travel purchases will soon eclipse more traditional online purchases, such as software and computers.



Purchase travel products (2.1 million users)

Browse for travel info (14.1 million users)

Source: Cyber Dialogue/FindSVP

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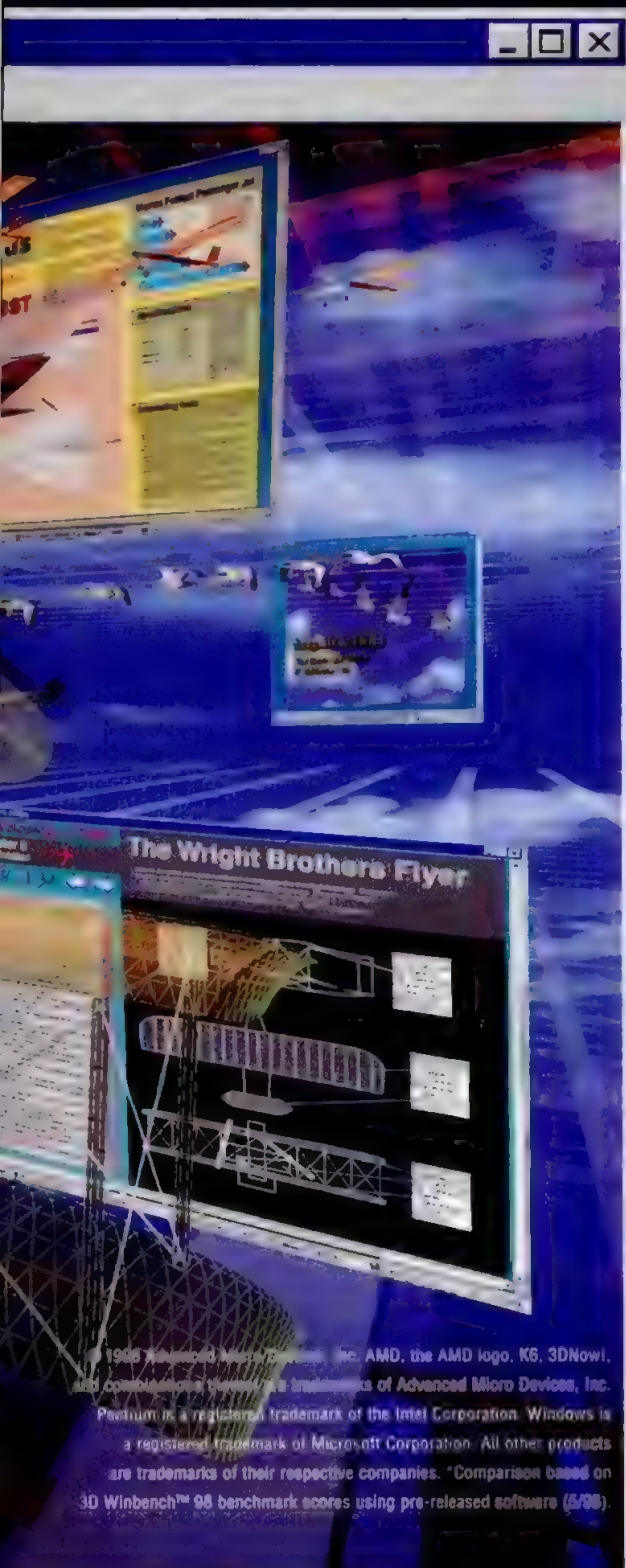
The third.



The AMD-K6-2 Processor
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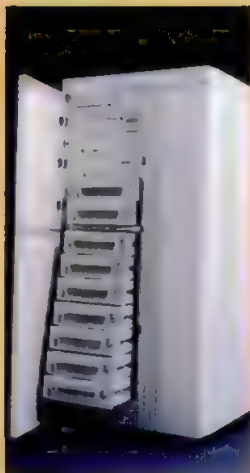
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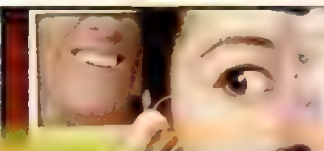
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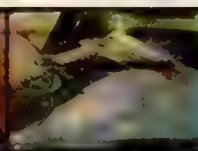
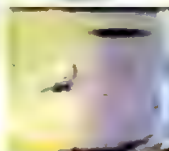


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Letters

WHERE DO I BEGIN?

I take issue with the feature story "Home on the Web" (September 1, 1998). I operate a small ISP for 3,000 local customers, all of whom get the very best in free, in-home technical support 7 days a week, phone support, and a staff that works overtime to create local online content. Local ISPs work overtime to make sure your total online experience is fast, friendly, and trouble-free. So where is the best place to start on the Web? Your ISP home page, of course. How else will you know about system announcements? How else will you know about new services? How else will you know about support issues, scheduled downtime, or new software?

You are misleading readers by suggesting they ignore the valuable information and content offered by a quality ISP—information that can make a difference if they miss it. Make the Web pages offered by other services your second click, not your start page.

JOE BOBBIER
via the Internet

I fail to share your excitement over Excite, *PC Magazine's* pick for the best Web portal. On entering the ZIP code 20815 for Chevy Chase, Maryland, I got a message saying that no information is available for that city. The same search on America Online properly identified the city and produced links. This does not give me much confidence in Excite.

MARTIN GREGOR
via the Internet

HOT, HOT, HOT

Thank you for adding information about heat management in your laptop reviews ("Traveling Powerhouses," August 1998). Poor heat dissipation and improper heat distribution can make even the most advanced laptop essentially unusable. And MIPS don't mean a thing if I can't keep my hands on the keyboard or the computer on my lap. Given two similar units, I will choose the one with the best heat distribution every time. Hopefully, adding this information in your stories will make designers more aware of the importance of this issue.

You may want to consider testing and printing heat distribution specs for laptops that are recharging. I use my laptop plugged in more than half the time, and I have noticed that the hot spots are not always in the same place when it's tethered to the wall as when it's not.

LEE A. CRACKER
via the Internet

SUPPORT WINDOWS 95

I read with great interest your article in the September 1 issue about speech recognition software ("Speak, Listen, and Learn," Trends/Software). I just found out that some



"So where is the best place to start on the Web? Your ISP home page, of course."

of the programs will not work with Windows 98. Dragon NaturallySpeaking has a Windows 98 beta patch, but Kurzweil will not support any of its current software for Windows 95. So everybody who has Kurzweil Voice or VoiceCommands is up a creek.

RUSSEL EIDE
Conneaut, Ohio

GET WIRED

In the July 1998 issue, you printed an article on wiring a home network ("The Perfect PC;" "Home Network"). You mentioned that each connected room should have "two high-quality RG6 coaxial cables for cable TV distribution and a data feed from a cable modem or satellite." Our local cable TV company is rewiring the entire city for broadband transmission, and it has specified that all of the current quad-shield RG6 cable must be replaced with RG11 cable in order to handle broadband. If this is correct, anyone wiring a home for CATV should probably wire with RG11 instead of RG6, in case broadband is installed in the future.

RICK ALEXANDER
Atlanta, Georgia

IN MICROSOFT'S DEFENSE

I don't often argue in Microsoft's defense. But after reading the Letters section of your September 1 issue, I feel compelled to set the record straight. I'm a second-year student of computer science at Purdue University. One of the first things we learned here is that it is theoretically impossible to write a bug-free program, so cut Microsoft a little slack. Windows 98 has a few

holes, but it's still a major improvement over previous versions of Windows. The Windows line of products, despite everyone's assertions to the contrary, is a fine collection of software that is good enough for most of us.

LANCE MCGRATH
via the Internet

I'm still running a 486DX2/66, and it crashed several times a day on Windows 95. By contrast, Windows 98 has made it almost crash-proof. I have to run the PC into the ground to get it to lock up. The only problem that I had while upgrading was that some file-transfer features for certain modems were not included in Windows 98. I just copied them from the Windows 95 disk. I strongly recommend this upgrade to anyone who suffers from lockups.

STEVE HOLSTEN
Kennett, Missouri

I would like to address those people who have written *PC Magazine* complaining about bugs in software (Windows 98 in particular). As a developer, I appreciate the complexity of an operating system probably more than most. Why is a PC unstable? A Unix workstation from HP, IBM, or Sun contains all the supported hardware "in the box." It also contains an OS composed exclusively for that machine and configured for that hardware. Is that stable? You bet.

Then Microsoft comes along and writes a generic OS for a generic PC, which can have any of a thousand different peripherals and software from any of a thousand different manufacturers. Microsoft's products, like those of any PC software vendor, will fall short of expectations. If you want bug-free software, buy a Unix box and limit your choices of software, processor, graphics card, sound card, modem, network card, scanner, label printer, and SCSI card.

REED O. HARDY
via the Internet

Unfortunately, Microsoft bashing is very much in vogue. I spend several hours a day on various Windows 98 technical BBSs helping folks with their problems and staying on top of the issues involved, and I support computers—mainly those of home users—for a living. I've installed Windows 98 on a number of different machines, smoothly and easily on all but one. (The "one" was a Compaq Presario. We resolved the problem by formatting the C: drive and getting rid of all the proprietary software Compaq had loaded.) Each user has had complete stability with Windows 98, as I have. The majority of folks on the BBSs have problems with outdated drivers, or hardware that isn't on the Windows 98 Hardware Compatibility List. Even so, the

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Canon

Letters

overwhelming majority are very pleased with the OS and find it to be stable and much improved over Windows 95.

PATTY MACDUFFIE
Portland, Oregon

COLLAR THE COLUMNISTS

Bill Howard's column on wireless LANs ("New Dimensions for Wireless LANs," September 1) was informative and interesting. There is a company he did not mention, however. MobileStar Network (www.mobilestar.com) is already providing wireless access for business travelers in those places they frequent the most: hotels, airports, and convention centers.

MOLLIE STEIGER
via the Internet

I have good news for John C. Dvorak, who in August lamented the fact that standard-cell rechargeable nickel hydride batteries are not available in the U.S. Actually, they are. About a week before I saw his column, I saw the batteries in my local Radio Shack in central California. According to an employee, they were introduced several months ago. So far, the store sells a two-pack of AA cells for \$9.99 and a 9-volt battery for \$12.99. The fast charger (approximately 2 hours) is about \$30.00. The AA batteries supply 1.2 Amp-hours. A close look at the package reveals that they are manufactured in France.

DAVID J. KIMBLE, JR.
via the Internet

Thanks for Dvorak's column on ever-more-onerous shrink-wrap licenses (September 1). I've just gotten my toes wet with Linux, and Dvorak's column gives me another incentive to wade right into the Open Source waters.

CALVIN DODGE
Denver, Colorado

How to Contact Us

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that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the last page of that column.

Corrections and Amplifications

In the sidebar "Manage Your Bookmarks" in the September 1, 1998, feature story "Home on the Web," we incorrectly said that you can't directly file a bookmark into a folder in Netscape Communicator (as you can with Internet Explorer). You can do so by selecting File Bookmark from the Bookmark menu.

Our First Looks review of Corel Ventura 8 ("Improving a Classic," September 1) states that the price for the upgrade is \$99. This was a limited offer, which has since expired; the current upgrade price is \$199.

In Trends/Networking (August 1998), we mistakenly reported the price for the Air ID as \$495. The price is \$199 for the kit and \$99 for each additional badge.

In the Net Tools feature on networking kits (September 1), the photographs for the NDC networking kits and the 3Com networking kit were transposed.

In From the Bench (September 1), we incorrectly reported the toll-free number for Mobile Automation. The correct number is 800-344-1150.

Jim Seymour's column "PC Industry: 'Don't Buy That New PC!'" (September 1) correctly identifies the most serious problem facing users of Windows-based PCs: the inability to upgrade to new PCs without reinstalling and reconfiguring all applications. Unfortunately, his proposed solutions—automated consolidation of configuration files by future operating systems, disk management utilities, or applications—are unhelpful. What's needed is a utility that allows users to image the disk on an existing PC and automatically transfer all applications, configurations, and data files to a new PC despite differences in hardware configurations.

RICHARD H. EBRIGHT
via the Internet

Jim, why don't you guys just get G3 Power Macs and make life easy? Most Mac programs store their preferences in a folder called, surprisingly enough, *Preferences*.

JOHN LEE
via the Internet

THE ORIGINAL PROGRAM

I was disappointed that Netopia's Timbuktu Pro was omitted from the roundup of remote-control software ("You Can Get There from Here," September 1). TB2 has a feature set very similar to pcAnywhere32. It also has a browser plug-in, notifies you when a client has become active, and lets the client give permission on a per-use basis for a remote user to gain access without a password via a dialog on the client. TB2 also has one feature not available from any of the others: It supports Macs as both clients and users. Timbuktu was the original remote-control software program.

MIKE KERNER
via the Internet

Timbuktu Pro was one of the original remote-control programs, and it does offer a lot of features, with the exception of one key feature—modem-to-modem connections, one of our filter items. This means that while the product

might be a great solution for help desks, it doesn't do a telecommuter or mobile worker any good. Netopia is adding modem-to-modem connectivity, so we covered Timbuktu Pro in a sidebar.—Ed.

Unfortunately, your feature story on remote-control software failed to include a DOS-based host product with Windows 95, a very common business application. Perhaps you could do a follow-up comparing the programs in this environment for all of us with DOS-based businesses.

DENNIS GALBRAITH
via the Internet

DIGITAL PERIPHERALS

I just read your First Looks roundup of digital cameras (September 1) and was astounded to find you didn't mention anything about the optics in the cameras. In particular, there's no indication whether the lenses are fixed-focus or zoom or what the focal-length equivalencies are. They are, after all, cameras, and the lens does make a difference. Digital cameras without telephoto capability are crippled by that limitation. Why have a million pixels if the image you want fills only a quarter of them?

JOHN ACKERMANN
via the Internet

In the Trends/Peripherals section of the August issue, you surveyed several new digital USB speaker systems ("Digital USB Audio"). In your description of the systems, you say that "they also provide a completely digital data path that bypasses the sound card and eliminates distortion associated with conversion to analog format." I think this statement is a bit misleading. With the new systems, the conversion from digital to analog is simply happening in a different place—in the electronics connected to the USB port of the speaker. I don't think distortion is eliminated: It's just happening in a different piece of hardware.

STEVE CELLINI
via the Internet

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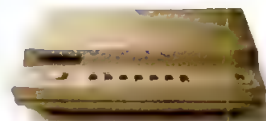


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Trends

Intel: Tanner On Tap

Details emerge on Intel's next high-end chip, due this winter.

Everyone wants to know about Tanner. Is it a beachgoer seeking sun or an antiquated British term for sixpence? Is it a craftsman who treats leather or a future Intel processor? It's all of the above—which, among PC users, leads to numerous follow-up questions. Will the chip resemble Xeon (Intel's current workstation and server chip, based on the Pentium II) or Merced (the 64-bit RISC-like chip due in the year 2000)? Will it plug into Slot 2 or Slot M? Will it arrive this year or next?

Though there's been much confusion concerning the processor's likely design, Intel recently disclosed that Tanner, due in the first quarter of 1999, is essentially a Xeon processor equipped with a new set of 3-D graphics instructions—the same instructions that will be used in the company's upcoming Katmai desktop processor.

In the spring of this year, rumors were circulating that Tanner was a chip meant to ease the transition from Xeon, which uses the new Slot 2 connector, to Merced, which will use the upcoming Slot M connector. As rumor had it, the processor would be based on the basic 32-bit architecture of the Pentium II yet use a Merced connector, allowing customers to purchase Slot M motherboards well before Merced arrives and then upgrade to the 64-bit chip in the fu-

ture. Though the Tanner code name was once, in all likelihood, attached to such a project, Intel now says that Tanner will offer a very different design.

As it stands, Intel offers the Pentium II for desktop machines and Xeon for workstations and servers. Whereas the Pentium II—using Slot 1—houses a 512K secondary cache that runs at half the processor's clock speed, Xeon can accommodate much larger caches that run clock-for-clock with the processor. Thus, when handling the massive data sets that workstation and server chips typically handle, Xeon processors—available with 512K, 1MB, and soon 2MB caches—perform much

faster than their desktop siblings.

In the first quarter of next year, Intel will replace the Pentium II—at least at the high end—with a chip code-named Katmai. This Slot 1 CPU will have the same core architecture as the Pentium II but will incorporate what Intel is calling Katmai New Instructions—a set of 70 instructions that, much like MMX Technology, are designed to enhance multimedia applications. Yet unlike MMX Technology, which is limited to integer-based calculations, Katmai New Instructions will deal primarily with 3-D rendering and other floating-point operations.

As Intel has now disclosed, Tanner will be, in essence, a Xeon processor augmented with Katmai New Instructions. Like the Katmai desktop chip, it will arrive in the first quarter of 1999, will use a 512K secondary cache, and will initially run at 500 MHz. In all likelihood, it will plug into Slot 2, interface with its L2 cache at full speed, and eventually offer much larger secondary caches. Also likely to use Xeon's 450NX chip set, it should be an option for four-way servers equipped with memory subsystems as large as 2GB to 4GB. Any additional information about Tanner is still forthcoming.

Following Tanner by at least a year will be Merced, a RISC-like chip based on the IA-64 architecture originally developed by Hewlett-Packard and Intel. In addition to running a new brand of 64-bit software, it will natively run IA-32 code (used by the Pentium and Pentium II families) and PA-RISC software (used by Hewlett-Packard's proprietary PA-RISC chip). IA-64 will initially be used on workstations and servers but should eventually become the industry's de facto standard platform.

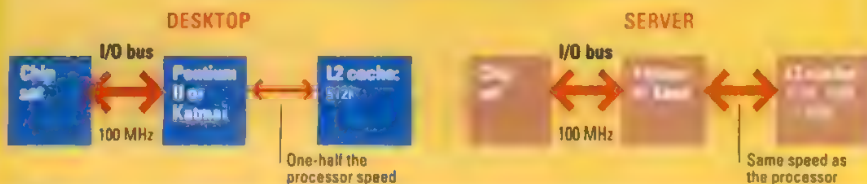
Tanner's repositioning brings up yet another question: Will Intel offer another processor with another code name as a transition from IA-32 to IA-64 architectures? Doubtless, the answer to that is no. Since Merced will run IA-32 software on its own, without software emulation or additional hardware, a transition processor is largely unnecessary. "The notion of a transition chip," says Bill Miller, director of press relations at Intel, "is a bit outdated."

—Cade Metz



Choose Your Cache: Half-Speed or Full-Speed

A Pentium II or Katmai processor houses a 512K secondary cache that runs at half the processor's clock speed. A Xeon or Tanner processor accommodates a much larger cache, which runs clock for clock with the processor and handles massive data sets.



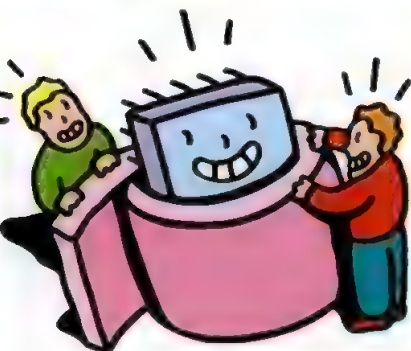
A Little Blankie For Faster Chips

In the quest for faster chips, IBM produces another breakthrough.

To develop a faster, cheaper, better computer chip, scientists are continually experimenting with new materials, designs, and manufacturing processes. The payoff could bring more than superfast computers. It could set the stage for more-accurate voice recognition software, notebooks and cell phones with superlong battery lives, and new hand-held Web gadgets that require very little power to operate.

Scientists at IBM recently perfected a manufacturing method that promises to increase chip speeds by 35 percent. They achieved this improvement by solving the problem of electrical interference caused when transistors are too close together. The millions of transistors on a chip are packed together so tightly that as the number of transistors increases, the electrical delays through the interconnects—the minuscule systems of wires and insulation carrying messages between transistors—become more frequent, limiting the speed of the transistor. Good insulators let chip designers place interconnects close together.

So by swaddling the millions of tiny transistors with a blanket of insulation, IBM engineers were able to reduce the electrical effects that slow performance. This protective blanket is called *silicon-on-insulator* technology and reduces the capacitance of the switch so it operates faster. (Capacitance is the ability to store



electrical charge.) The result could be chips that require as little as one-third the power of today's chips. IBM expects to use the technology in its chips beginning next year.

The news comes less than a year after IBM introduced a technology that solved another speed-inhibiting problem, one caused by a chip's aluminum wires. According to IBM engineers, aluminum's inefficiency inhibits a chip's electrons from moving fast enough. Outfitted with copper wires, chips may well run at a whopping 1 gigahertz.—Carol Levin

What Color Is That?



You'd probably think that testing a scanner's color accuracy would be easy. Take a target, scan it, view it on-screen or print it, and compare the result with the original. You would, of course, be wrong.

The core problem is that all scanners and monitors (and most printers) define colors with device-dependent color models, so the definition for any given color varies from one device to another. (In contrast, the CIE chromaticity diagram—shown here—is device-independent, because it describes colors in terms of human perception.)

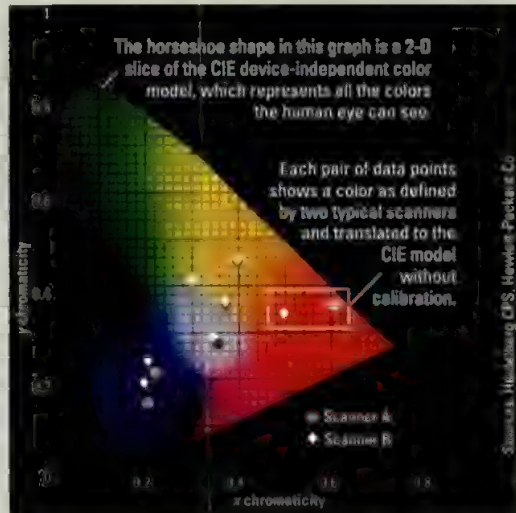
Scanners and monitors are RGB devices, so called because they define all colors as mixtures of red, green, and blue. Device-dependence means that what one scanner sees as 1 part blue to 3 parts red, another scanner or a monitor may define as 1 part blue to, say, 3.3 parts red.

The classic solution for matching colors between devices is to calibrate the devices, or build a profile to map the colors for one device to the colors of another. Unfortunately for anyone who wants to test the color accuracy of scanners, calibrating each scanner to, say, the same monitor and comparing results isn't meaningful.

The comparison you need is with the target that you're scanning, and since you can't calibrate the test monitor to the target without scanning the target first, you would actually wind up calibrating the monitor to a particular scanner. To get beyond this tail-swallowing act, you have to convert both the scanned results and the colors of the original target to a device-independent color model such as the CIE model.

There's a problem here, too: To convert the results, you need to know some details about or make assumptions about the

color model for each scanner. If you convert the results from each scanner based on its own color model, the converted results won't match what you'll see on-screen in most programs. If you simply make assumptions, any scanners that happen to match the assumptions will get an unfair advantage.



Source: Munsell Color Services Laboratory

The ideal solution is to judge the scanners in the context of a standard color space or color management system that all the devices on the computer—scanners, monitors, and printers—are actually trying to match. At this writing, there's no such color space for

the PC—at least, none that is widely used. (The Mac has one, called ColorSync.) Windows 95 offers ICM (Image Color Matching), but ICM has enough flaws that few programs or devices bother to use it. All of which explains why we couldn't run useful color-fidelity tests for the scanner reviews to appear in our next issue.

Windows 98, however, offers a hope for the future, with a much-improved version of ICM. ICM 2.0 is similar to the Mac's ColorSync, and it takes advantage of the same ICC (International Color Consortium) profiles to define the colors for individual scanners and other devices.

If ICM 2.0 becomes popular, with support from most software, printers, monitors, and scanners, it will serve as the basis for testing scanner color fidelity in the future. (Note that ICM 2.0 uses the sRGB model—a device-independent version of the RGB color space—as its default profile, so sRGB printers and scanners, available primarily from Hewlett-Packard, don't need separate ICC profiles.) For the moment, however, there's no good way to define a scanner's color accuracy in the context of PCs, which is something you'll just have to live with.—M. David Stone

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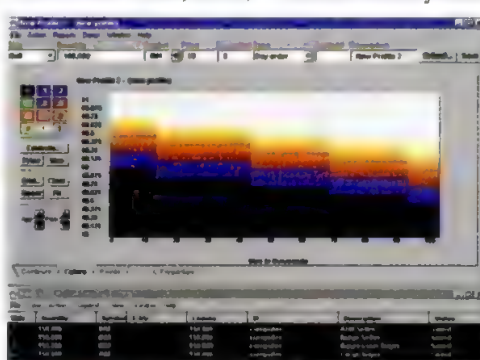
As individual investors turn to the Web en masse to trade stocks, they're getting access to some of the privileges previously available only to giant institutional investors. Some sites, for instance, now offer early bites at IPOs, and with the help of a new trading system that kicks into action this fall, small-fry investors can also benefit from "price improvement"—essentially, the chance to buy or sell stock at a better price than what you've bid or asked.

Until now, only large institutional investors buying and selling vast amounts of stock had access to such deals. "Price improvement has seldom been available to individual investors," says Marc Groz, vice president of research at OptiMark. "Now, through OptiMark's ability to aggregate small orders, individuals can participate on a level playing field with institutional traders." Although in-

dividual investors won't have access to OptiMark, they'll benefit collectively because many brokers will have access to it.

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and Pacific Exchange, relies on a profile an institutional investor completes that specifies pricing, volume, and—here's the unique part—level of satisfaction. It's this third dimension, the degree of willingness to trade at each price and size, that enables OptiMark to uncover hidden liquidity. "The genius of the algorithm is in matching up buyers' and sellers' preferences so that the overall level of satisfaction in the market is optimized," Groz says.



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strategy a secret—especially critical for big investors with the clout to move prices.

OptiMark will have plenty of competition with the existing electronic trading systems. Instinet, owned by Reuters Holdings, is the pioneer in electronically matching buy and sell orders. And Datek Online's Island system, launched in

1996, is one of the largest electronic communication networks approved by the SEC; it claims to handle 5 percent of the Nasdaq stock market's daily volume.—Carol Levin

JAKE KIRCHNER

You Can't Run PR on a PC

One of the charges sometimes made against Microsoft is that the company is primarily a great marketing force, making up for poor technology through predatory business tactics and uncommonly forceful public relations efforts that help it win market share with inferior products.

The PR part of this negative image is considered in great detail in the September issue of *Brill's Content*, the fascinating and controversial new magazine that examines modern media for accuracy and professionalism. The 15-page article "Making Bill" lays out the history of Microsoft's efforts to promote Bill Gates, enhance the company's image, and ensure the success of its products.

An early comment sums up the point of the article: "Adroit, aggressive PR did not create Bill Gates or Microsoft, nor does the reality of it negate Gates's accomplishments as a businessman or the appeal and supremacy of his company's products. But... its savvy PR tactics may have made the difference between victory and defeat."

The article will captivate anyone in the computer industry, but it fails to answer key questions raised. The magazine quotes dozens of journalists who level complaints against the company's PR machine, all of which are duly answered in plausible statements from Microsoft spokespersons. It's hard to discern the truth of many of the allegations.

PC Magazine has certainly been subjected to more Microsoft PR than most publications. Often we've benefited from that PR by getting access to key Microsoft products we've needed to test and through having access to key Microsoft staff, including Bill Gates. From that standpoint, we're in a good position to address some of the unresolved issues brought out in *Brill's Content*.

In one section the article quotes several people as stating that Win-



dows is today technically inferior to IBM's OS/2 but has bested IBM's operating system through superior and sometimes questionable marketing tactics. Actually, although OS/2 was technically superior, it failed to garner support from hardware and software vendors.

Elsewhere the article suggests Windows 95 was not a technological breakthrough but was successful largely because of the Microsoft-orchestrated media hype. Actually, Windows 95 was a major upgrade and was successful because it was acceptable to the PC makers,

which shipped the new OS on tens of millions of PCs.

In a sidebar on Microsoft's relationships with computer publications, *Brill's Content* says Microsoft's extensive hand holding of the publications' reviewers leads to positive reviews. It quotes a Microsoft representative as saying the company's contact with one of our writers helped generate a "very positive" review for Internet Explorer 4.0 in *PC Magazine*. In fact, both Microsoft and its Internet competitor Netscape have had consistent contact with us throughout our last two major Web browser reviews. In one case Internet Explorer received our Editors' Choice award; in another Netscape's Navigator did.

Finally, the article contains charges that Microsoft's PR is aimed "at the top of the press chain," denying access to "the few journalists who understand the nitty-gritty of software code." This is just plain false. The company holds many technical conferences that are open to the press and makes available all the technical resources that we need to test products in our labs.

I'm not saying the Microsoft PR effort is a Boy Scout organization. It is not. It can be overbearing and sometimes is just plain counterproductive. But the company still has to make its fortune based on its products. At least in our pages.

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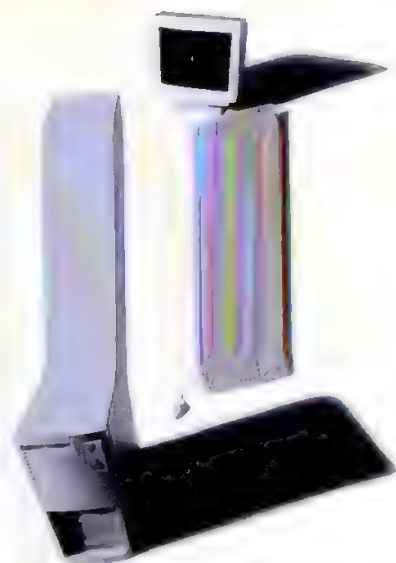


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PCs

Celeron CPU Caches Up, Adds Muscle to Basic PCs

Intel's Celeron line of processors, criticized by some for lackluster performance, gets a shot in the arm with the introduction of new 300-MHz and 333-MHz versions, both of which offer a key performance feature not seen before in Celerons: Level 2 cache.

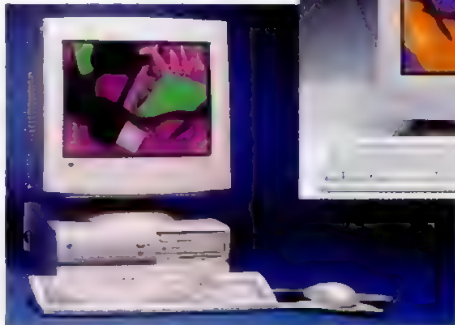
Arriving ahead of their anticipated availability, the new 300-MHz (designated the 300A) and 333-MHz Celerons come with 128K of Level 2 cache built directly onto the CPU die, a design element which allows the cache to run at the full speed of the processor. Although Pentium II processors come with 512K of Level 2 cache, the cache is not built onto the CPU die but connected via a bus that runs at half the speed of the CPU.

Celeron CPUs use the same P6 core architecture and Slot 1 connector as Pentium IIs but have less casing and are often matched with motherboards using Intel's low-cost EX PCI chip set instead of the more robust LX or BX chip sets.

According to Intel, the new cache design allows the Celeron/333 and Celeron/300A to offer performance advantages of up to 38 and 25 per cent, respectively, over the cacheless Celeron/300. The company says, however, that Pentium II CPUs will maintain a 7 to 11 percent performance advantage over the new Celerons at the same clock speeds. Look for *PC Magazine's* First Looks roundup and comparison of the first Celeron/333-based PCs from Compaq, Dell, Hewlett-Packard, and Micron

Electronics in the issue of October 20, 1998.

Public demand for Celeron PCs has been lukewarm since their performance has often been viewed as more Pentium-class than Pentium II-class. For example, three of the five Celeron/266-based PCs in our September 1, 1998 roundup of \$999 PCs yielded ZD Business Winstone 98 test scores that were lower than that of a Pentium MMX/



233-based unit. Even Intel's iCOMP index gauging processor performance puts the Celeron/266 and Celeron/300 (iCOMP index 213 and 226, respectively) just ahead of a Pentium MMX/233 CPU (iCOMP index 203).

Gateway (800-846-4208, www.gateway.com) will use the new Celerons in its E series of managed corporate PCs. The DMI 2.0-compliant E-1200 slim-line units come with Intel LAN-Desk Client Manager 3.3 and use a slide-out motherboard with integrated features such as Intel's EX PCI chip set, an ATI Rage IIC AGP graphics chip set with 4MB of graphics memory, Sound Blaster-compatible audio hardware and an Intel Ethernet adapter with Wake on LAN support. The \$999 Gateway E-1200 333 is configured with a Celeron/333, 32MB of SDRAM, a 3.2GB hard disk, a Gateway EV500 15-

inch monitor, Windows 95 or 98, and a three-year warranty, but no CD-ROM drive.

Monorail Computer (888-880-7245, www.monorail.com) uses the new Celerons for both its low-cost home and business lines. The Monorail 6030 micro-tower home PC uses Intel's EX chip set and comes with a 4.2GB hard disk, 48MB of SDRAM, a 32X CD-ROM drive, a 56.6-Kbps modem, an AGP graphics card with 3-D video acceleration and 4MB of VRAM, 3-D audio hardware, speakers, Windows 98, and a one-year parts-



CACHE AWAY!
Celerons
from (clock-
wise) Mono-
rail, NEC,
and Gateway.



and-labor warranty.

The Monorail NPC 5330 mini-tower business PC comes with the same hard disk, CD-ROM drive, graphics card and audio hardware as the above Monorail unit but uses Intel's LX chip set. It features 32MB of SDRAM, an Intel PRO/100+ PCI Ethernet adapter, and Intel LANDesk Client Manager. The unit comes with Windows 95 and a three-year parts, one-year labor warranty.

Celerons will continue to be used in NEC Computer Systems Division's (888-863-2669, www.nec-computers.com) NEC PowerMate 5100 series of low-cost

managed PCs. A minimal configuration in this line features a Celeron processor and 32MB of RAM, a 2.1GB hard disk, an integrated AGP graphics chip set with 2MB of SGRAM, integrated 16-bit audio, a 3Com Ethernet adapter, and Windows 95. A three-year warranty includes on-site service for the first year and 90 days of free software support.

Whereas CompUSA (800-266-7872, www.compusa.com), which offers build-to-order PCs, says it will add the new Celerons to its menu of CPU choices as soon as possible, the IBM Personal Computer Co. (800-426-7235, www.ibm.com/aptiva) has no current plans to incorporate Celerons into its Aptiva consumer PCs.

The debut of the new Celerons (often referred to by their code-name "Mendocino") brings the end of the line for the Pentium CPU into plain view. Intel has stopped making wafers for Pentium MMX processors and is filling orders only through the end of 1998. That the 233-MHz to 300-MHz Pentium II CPUs are being phased out is logical, since they overlap with the family of Celeron chips in terms of performance and were built with the older 0.35-micron process instead of the more efficient 0.25-micron process used in 333-MHz and faster Pentium II CPUs and all newer Celerons. In 1999, the Celeron/266 will represent Intel's entry-level desktop CPU.

Intel's pricing clearly anticipates the end of the Pentium. At press time, the Celeron/333 and Celeron/300A were priced at \$192 and \$149, respectively, in quantities of 1,000. By contrast, the Pentium II/233, Celeron/300, and Pentium MMX/233 were priced at \$161, \$112, and \$106 for the same quantity.

The next step for the Celeron line will be a 366-MHz version, slated to be available in early 1999.—Robert S. Anthony

RECAP Five of the 37 sub-\$1,000 systems we reviewed in our issue of September 1, 1998, used Celeron CPUs. The Axis Orion LXN266 was an Editors' Choice recipient.

Trends Software

GRAPHICS SOFTWARE

Getting Down to Business

Consumer-oriented image editors seem to be the center of attention, but that doesn't mean that the needs of small businesses are getting lost in the shuffle.

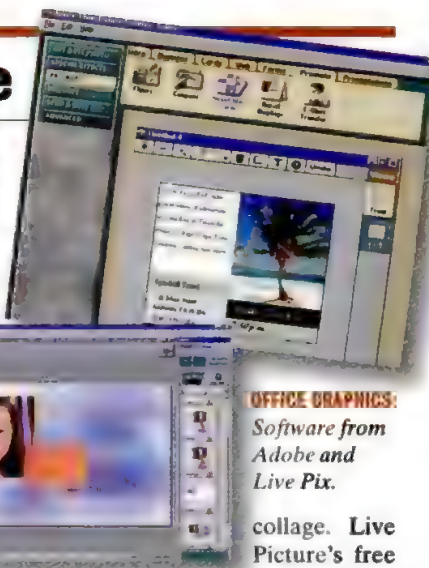
Adobe (800-238-5972, www.adobe.com) recently released a separate version of its consumer-oriented image-editing product, the \$100 street **PhotoDeluxe Business Edition**, designed for the SOHO market. This version has a

nearly identical interface and uses the same technology as the home version. But the Projects area has a Business tab that leads to sets of projects designed specifically for businesses (such as real estate, marketing, and travel) that frequently require the use of image editing. Like Home Edition, Business Edition includes Adobe Connectables, which allows you to expand the library of templates.

Similarly, Live Picture (800-727-1621, www.livepix.com) has also

produced a business version of its image editor, called **LivePix SOHO** (\$50 street). LivePix SOHO includes the same image-editing tools as LivePix 2.0; if you already

have that program installed, SOHO simply adds the business content and templates. SOHO includes two main areas: Photos and Projects. An innovative feature is its ability to blend background colors automatically in an image to create a seamless



OFFICE GRAPHICS: Software from Adobe and Live Pix.

collage. Live Picture's free monthly down-

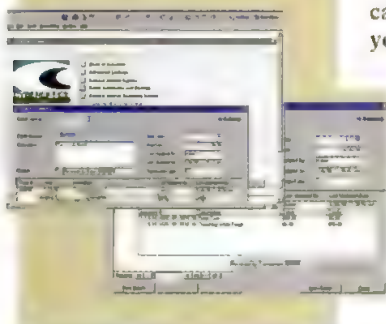
loads make it easy for you to expand on the included templates. —Matthew Graven

CyberOffice

Designed for small to medium-size companies, **CyberOffice** (starting at \$2,995 list for one seat) is a business information management system from CyberOffice Technologies LLC (888-971-2500, www.cyberofficetech.com). CyberOffice, which is fully integrated with Microsoft Office, links together a comprehensive set of accounting modules with manufacturing, purchasing order entry, inventory, and contact management modules. The integrated modules allow all members of a company access to the information they need to fulfill their specific functions.

At the core of CyberOffice is an accounting program which provides companies with a general ledger, accounts payable and accounts receivable modules, as well as payroll and bank reconciliation features—all in one interface.

—Sharon Nash



PERSONAL DOCUMENT MANAGEMENT

Too Much Information?

Frustrated by constant information overload? Enfish Technology (888-222-3634, www.enfish.com) and Visioneer (800-787-7007, www.visioneer.com) both offer new products designed to assist in organizing your otherwise chaotic glut of documents.

Enfish Tracker Pro (\$80 street) gives you a single place to go for all of your information, regardless of file type and where it resides—on a local hard disk, an intranet, or the Internet. An acronym for ENTER, Find, and SHare, Enfish automatically cross-references and links related information from many sources using Enfish's patented DEX technology.

All of your files are indexed in the background as you work, thereby not causing any disruption to your work flow. Files can be organized according to projects, topics, and priorities. You'll be alerted when new information arrives, so that instead of roaming from program to program to deal with each task of the day, you need only to go to Enfish to gain access to all of

your files. In turn, having all of your information organized in one place might help you increase productivity.

Promising to transform your standard Windows 95/98 desktop with a visual way to find, view, and send files, **Visioneer Visual Explorer** (\$50 street) builds on Visioneer's popular PaperPort Desktop and offers a thumbnail-

ated applications when double-clicked.

Alternatively, the Visioneer PageView feature lets you view files without opening the original application. The files can be annotated, faxed, filed, or attached to an e-mail message. Once installed, Visual Explorer



TWO PATHS TO YOUR DATA: Visual Explorer (above) goes the visual route, whereas Enfish Tracker Pro provides descriptive indexes.

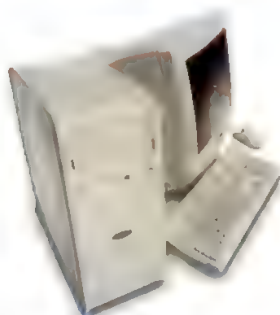
based view of your system's data files. Most of the files on your Visual Explorer desktop are represented as miniature icons which automatically launch the associ-

automatically scans the hard disk and inventories all of your data files on the desktop. Visual Explorer works in the background while your computer is idle and creates a link bar that appears at the bottom of your screen. Icons on the link bar allow the user to e-mail, fax, print, or discard files with a single mouse click. The Simple-

Search feature lets you find any document or Web page based upon annotations, title, URL, HTML, or full document content. —Sharon Nash



THEY WOULDN'T GIVE YOU THE TIME OF DAY.
THEY SAID YOU WEREN'T A PLAYER.
THEY WOULDN'T ACCEPT YOUR GAINS.
THEY'RE HOLDING ON LINE THREE.



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Faster...Faster...Faster...

1 Clocking at speeds over 600MHz, the cheetah is the fastest land animal. This "big cat" hunts mainly gazelle, but the average chase lasts only about 20 seconds.

2 In early September 1998, PC World Magazine ranks the Micron Millennia the #1 Power Desktop on the market calling it "the fastest of all" systems tested.

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Defense Contractor



Micron Systems:
Over 100,000 deployed Micron desktops, notebooks & servers

Favorite Feature:
Price/power ratio

Purpose:
Help maintain US security and freedom

For The Whole Story: www.micronpc.com

Tim Willits
Lead Map Designer, Id Software
Creators of Quake & Quake II



Micron Systems:
Micron Millennia 400s desktops

Favorite Feature:
400MHz - Of course

Purpose:
Test mind-bending levels of Quake II and help create one of the coolest games ever

For The Whole Story: www.micronpc.com



Featuring Intel's Fastest Processor Ever

Just named #1 Power Desktop by the editors of PC World Magazine (Millennia 400 DVD - September '98) Micron's Millennia desktop product line continues a long tradition of industry-leading, award-winning performance. Perhaps that's why some of the most prominent power users around rely on Micron. No



matter how strenuous your demands, no matter how colossal the task, we invite you to put a Millennia desktop to the test.

You'll be hard-pressed to find a Pentium®II processor based system as powerful and affordable as the Micron Millennia. And Micron's revolutionary new mPower™ purchase program makes Millennia ownership even easier, offering qualified users no interest* or payments for six months as well as PowerXchange™ trade-in options on your current PC towards a new Millennia desktop.

MICRON RANKED #1 DESKTOP CUSTOMER SATISFACTION**

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3 The fastest typist in the world types 170 words per minute. To give you some idea of how many words that is, this little blurb is only 30 words long.

4 The newest Micron Millennia features the Intel Pentium II processor 450MHz, the fastest chip available. Don't settle for anything less.

THERE IS NO KNOWLEDGE THAT IS NOT POWER.

— RALPH WALDO EMERSON

10
VOL. 11, SEC. 01
98.10

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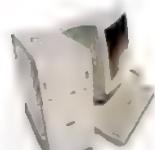
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Model Name **Millennia C300**



Model Name **Millennia 350**



Model Name **Millennia 400**



New!
Model Name **Millennia 450**



New!
Model Name **Millennia 450 MAX**

Processor	Intel® Celeron™ processor 300MHz	Intel Pentium® II processor 350MHz	Intel Pentium II processor 400MHz	Intel Pentium II processor 450MHz	Intel Pentium II processor 450MHz
RAM	32MB SDRAM	64MB 100MHz SDRAM	64MB 100MHz SDRAM	64MB 100MHz SDRAM	128MB 100MHz SDRAM
Hard Drive	4.3GB Ultra ATA hard drive	8.4GB Ultra ATA hard drive	10GB Ultra ATA hard drive	10GB Ultra ATA hard drive	16.4GB 7200 RPM Ultra ATA hard drive
Monitor	15" Micron 900Hz monitor (15.8" display)	17" Micron 700Hz monitor (15.9" display)	17" Micron 700Hz monitor (15.9" display)	17" Micron 700Hz monitor (15.9" display)	19" Micron 900Hz monitor (18" display)
DVD/CD-ROM	32X max speed CD-ROM drive	32X max speed CD-ROM drive	32X max speed CD-ROM drive	32X max speed CD-ROM drive	DVD-ROM drive and decoder card***
Graphics	nVidia Riva 128, 4MB SGRAM 3D AGP graphics	nVidia Riva 128, 4MB SGRAM 3D AGP graphics	nVidia Riva 128, 4MB SGRAM 3D AGP graphics	nVidia Riva 128, 4MB SGRAM 3D AGP graphics	Real 3D Starfighter 1740, 8MB AGP graphics
Sound System	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable 3D stereo sound
Cache	128KB internal cache	512KB internal cache	512KB internal cache	512KB internal cache	512KB internal cache
Warranty	5-year/3-year Micron Power™ limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty

Software Included	Microsoft® Windows® 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition
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Also Includes:	New MicroTower™ case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse™ 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse 3.5" floppy drive	Micron MiniTower case Advent AV390PL-70 watt 3-piece sound system Advent subwoofer 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse 3.5" floppy drive
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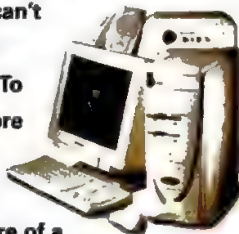
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OBsolescence PROTECTION

3. Other computer companies make you wait 2 to 4 years before you can trade up, and many hold you to restrictive finance agreements. With Micron you're eligible to upgrade a system anytime from 12 to 48 months after purchase, regardless of how you finance your purchase. Plus, you can trade in your old machines for wholesale credit which apply towards the purchase of new machines.

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4. Some manufacturers force you to purchase pre-selected software packages to qualify for their programs. Not Micron. We offer unparalleled hardware and software flexibility with all our custom-configured machines.

MICRON ANNOUNCES BREAKTHROUGH PRICING ON AWARD-WINNING SYSTEMS



New!

Model Name **Millennia® 450**

Processor Intel® Pentium® II processor 450MHz
RAM 64MB 100MHz SDRAM
Hard Drive 10GB Ultra ATA hard drive
Monitor 17" Micron 700Hz monitor (15.9" display)
DVD/CD-ROM 32X max speed CD-ROM drive
Graphics nVidia Riva 128, 4MB SGRAM 3D AGP graphics
Sound System PCI 64-voice Wavetable sound
Cache 512KB Internal cache
Warranty 5-year/3-year Micron Power™ limited warranty

Software Included Microsoft® Windows® 98
Microsoft Office Small Business Edition

Also Includes: New MicroTower™ case
Advent AV009 stereo speakers
3Com/U.S. Robotics 56K WinModem**
104-key enhanced keyboard
Microsoft IntelliMouse®
3.5" floppy drive

Millennia 400

Processor Intel Pentium II processor 400MHz
RAM 64MB 100MHz SDRAM
Hard Drive 10GB Ultra ATA hard drive
Monitor 17" Micron 700Hz monitor (15.9" display)
DVD/CD-ROM 32X max speed CD-ROM drive
Graphics nVidia Riva 128, 4MB SGRAM 3D AGP graphics
Sound System PCI 64-voice Wavetable sound
Cache 512KB Internal cache
Warranty 5-year/3-year Micron Power limited warranty

Software Included Microsoft Windows 98
Microsoft Office Small Business Edition

Also Includes: New MicroTower case
Advent AV009 stereo speakers
3Com/U.S. Robotics 56K WinModem**
104-key enhanced keyboard
Microsoft IntelliMouse
3.5" floppy drive

New!

TREK™ 300

Processor Intel Pentium II processor 300MHz
RAM 64MB SDRAM
Hard Drive 3.2GB hard disk drive (removable)
Monitor 14.1" XGA TFT display
DVD/CD-ROM 24X CD-ROM drive (dedicated bay)
Graphics 4MB video graphics accelerator
Sound System Built-in stereo speakers & microphone
Cache 512KB L2 pipeline burst cache
Warranty 5-year/1-year Micron limited warranty

Software Included Microsoft Windows 98
Microsoft Office Small Business Edition
System Wizard Mobile Client™
Norton AntiVirus

Also Includes: Zoomed Video capable
Li-Ion battery (dedicated bay)
Microphone, stereo line-in/out jacks
Touchpad pointing device
CardBus ready
S-Video & NTSC out; MPEG compatible
Wavetable/3D Positional Sound
2 Type II/1 Type III PCMCIA slots
2-USB, parallel, serial, VGA, PS/2 ports
2-way fast infrared port
Modular floppy drive (dedicated bay)

New!

GoBook™ 300

Processor Intel Pentium II processor 300MHz
RAM 64MB EDO RAM
Hard Drive 3.2GB hard drive
Monitor 12.1" SVGA display
DVD/CD-ROM 24X modular CD-ROM drive
Graphics PCI bus with 128-bit graphics accelerator
Sound System 16-bit stereo/Wavetable sound
Cache 512KB L2 pipeline burst cache
Warranty 5-year/1-year Micron limited warranty

Software Included Microsoft Windows 98
Microsoft Office Small Business Edition
System Wizard Mobile Client™
Norton AntiVirus

Also Includes: Bay battery
4.4lbs (w/floppy drive)*
6.7lbs (w/opt./base battery & floppy)
USB, parallel, serial, VGA, PS/2,
NTSC/S-Video ports
MPEG compatible
CardBus/Zoomed Video ready
Microphone, stereo line-in/out jacks
2 Type II/1 Type III PCMCIA slots
2-way infrared port
Touchpad pointing device
Modular floppy drive
Add SuperBase Battery for \$299

Price

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TechRefresh Bus.
Lease, 36 mos.**

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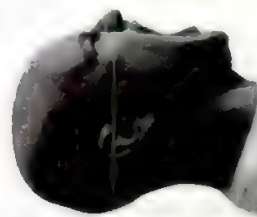
\$2999 \$105/mo.
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Lease, 36 mos.**

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*See also recent "Micron Wins" - System Wizard Mobile Client not available with Windows NT. **Used with Dell Computers to reward customer satisfaction with post-on month financing purchase. Source: PCWeek Desktop PC's panel. Note: TechRefresh lease prices are based on a 36-month lease and are available to business customers. Businesses can qualify for 60-day same-as-cash and individuals for 6-month same-as-cash programs. It not paid in full by end of period, finance charges will be assessed from purchase date. APR varies and is 17.99% as of 1/1/98 with a minimum finance charge of \$1.00. Term financing is available to individuals for home or business use. PowerEdge example trade-in of most major computer brands. Please call for details and the latest qualified brand list. Cash rebates are based on the average wholesale value of your PC per the Open Buy Back, adjusted for number of trade-ins. A non-refundable up-front freight charge applies for participation in PowerEdge to cover cost of return packaging and processing.

Planes that cost millions of dollars have "mechanical

failure." Two airport hotdogs is too many. I played 18 holes

between spreadsheets. I wonder where they're all going? When

you say it over and over again, "delay" starts to sound funny.

Lying down would be good. Three dollars is a lot for water.



PLAYED



"FOR STANDING UP TO THE VAGARIES OF TRAVEL, THE MICRON GOBOOK IS THE BEST BET GOING."

ENR "EDITORS' CHOICE" BEST ULTRAPORTABLE REVIEWER, MAY '98

GOBOOK²



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You don't get to recharge your batteries every four hours. You don't get to rest whenever you feel like it. Why should your notebook? Life on the road is no cakewalk and your notebook should be designed to endure the rigors of mobile life as well as you do. Introducing the GoBook notebook. With a revolutionary modular battery design, lightning-fast performance featuring the fastest Intel® Pentium® II processors, and an incredibly thin and light package, it's the ultimate companion for those who stop at nothing to succeed. It's no wonder that CNET just awarded the GoBook Editors' Choice for best UltraPortable on the market, saying, "For standing up to the vagaries of travel, the Micron GoBook is the best bet going."

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Solitaire is actually pretty fun for about a minute. That person looks like some-

body I know. I'm actually excited about the prospect of getting on a plane.

Why isn't my cell phone working? That kid keeps staring at my GoBook. This is

better than being in the office. I guess. What's that smell?



YOUR ONLY FRIEND DURING A THREE-HOUR LAYOVER



10
VOL. 6 SEC. 01
98.10

"It's not enough to be easy. The question is: What are we easy about?"

"The GoBook outperformed every other machine in our review by a sizeable margin" *CNET*, Editors' Choice, Best UltraPortable Reviewed, May '98



Here's the GoBook difference: Featuring the fastest Intel Pentium and Pentium II processors • Preloaded with Microsoft's Windows 98 • Includes a big active matrix 12.1" SVGA display powered by 128-bit graphics accelerator • A revolutionary modular battery design that performs

as well traveling across town as it does across the Atlantic Ocean • Big room for expandability: The GoBook includes both a 24X CD-ROM drive and a 3.5" floppy drive • All in a super thin and light package that starts at just 1.35" thin and 4.4lbs.*



Model Name

GoBook™ 266

GoBook² 233

**New!
GoBook² 300**

Processor Intel® Pentium® processor with MMX™ technology 266MHz
RAM 32MB EDO RAM
Hard Drive 3.2GB hard drive
Monitor 12.1" SVGA display
CD-ROM 24X modular CD-ROM drive
Graphics PCI bus with 128-bit graphics accelerator
Sound System 16-bit stereo/Wavetable sound
Cache 512KB L2 pipeline burst cache
Warranty 5-year/1-year Micron limited warranty

Processor Intel Pentium II processor 233MHz
RAM 64MB EDO RAM
Hard Drive 3.2GB hard drive
Monitor 12.1" SVGA display
CD-ROM 24X modular CD-ROM drive
Graphics PCI bus with 128-bit graphics accelerator
Sound System 16-bit stereo/Wavetable sound
Cache 512KB L2 pipeline burst cache
Warranty 5-year/1-year Micron limited warranty

Processor Intel Pentium II processor 300MHz
RAM 32MB EDO RAM
Hard Drive 3.2GB hard drive
Monitor 12.1" SVGA display
CD-ROM 24X modular CD-ROM drive
Graphics PCI bus with 128-bit graphics accelerator
Sound System 16-bit stereo/Wavetable sound
Cache 512KB L2 pipeline burst cache
Warranty 5-year/1-year Micron limited warranty

Software Included Norton AntiVirus
System Wizard Mobile Client™
Microsoft® Windows® 98

Software Included Norton AntiVirus
System Wizard Mobile Client™
Microsoft Windows 98
Microsoft Office Small Business Edition

Software Included Norton AntiVirus
System Wizard Mobile Client™
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Microsoft Office Small Business Edition

Also Includes: Bay battery
4.4lbs (w/floppy drive)*
6.7lbs (w/opt./base battery & floppy)
USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports
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CardBus/Zoomed Video ready
Microphone, stereo line-in/out jacks
2 Type II/1 Type III PCMCIA slots
2-way infrared port
Touchpad pointing device
Modular floppy drive
Add SuperBase Battery for \$299

Also Includes: Bay battery
4.4lbs (w/floppy drive)*
6.7lbs (w/opt./base battery & floppy)
USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports
MPEG compatible
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2 Type II/1 Type III PCMCIA slots
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**- John C. Dvorak, PC Magazine,
Sept. 1, 1998**

The DPP 500 PowerPanel delivers a **bright, sharp, digital image** that no analog display can match. From the smallest text to the fastest graphic animation, the DPP 500 offers **new levels of realism and detail**. The PowerPanel's active matrix TFT XGA display completely eliminates screen flicker, focus and convergence problems, while ensuring **100% edge-to-edge image sharpness**. And the DPP 500 also includes an ATI Graphics card that, combined with Windows® 98, allows you to **view images on two monitors** simultaneously.** The DPP 500 also features a built-in microphone and stereo speakers.*** The DPP 500 PowerPanel. **Pure Digital. Pure Power.** Only from Princeton, the display technology leader for over 20 years.



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Trends Peripherals

UNIVERSAL SERIAL BUS

USB in the Spotlight

With the arrival of Windows 98, the Universal Serial Bus (USB) ports on your PC are finally ready for action. The much-touted chief benefit of USB is the ability to daisy-chain devices together without loss of bandwidth, thus freeing up serial, parallel, and PS/2 ports on your PC. And with an add-on hub (whether on your desktop or built into your monitor), you can connect and disconnect devices easily, without having to reach behind your computer.

A smattering of USB peripherals have been released so far (a page scanner here, a videoconferencing camera there), but this fall will see the delivery of more mainstream devices.

Logitech (510-795-8500, www.logitech.com) has released a USB version of its ambidextrous, three-button scroll-wheel mouse, the

Logitech USB Wheel Mouse (\$40 street).

Because of USB compatibility, the mouse can be plugged and unplugged without rebooting the computer.

ITAC Systems (800-533-4822, www.mousetrak.com) now sells a USB version of its contoured trackball, the **ITAC evolution**

THEY'RE HERE:
USB peripherals from ITAC, Epson, Logitech, and Imation (clockwise from left).

MouseTrak (\$99 list). Thanks to the device's USB interface, there's no need for a special driver; simply plug the device in and start mousing.

Storage manufacturers are turning to USB, too. Imation Corp. (888-466-3456, www.superdisk.com) is already selling a \$189 USB version of its 120MB **Imation SuperDisk** drive for the Macintosh environment, and a PC-compatible version will be available by the end of the year. Meanwhile,

Imation Corp. (800-697-8833, www.imation.com) is readying the **Imation USB Zip Drive** for release by the end of this year; the drive will be priced at under \$150 on the street.

Not to be left out, printer vendors are getting in on the USB act. Epson America (800-463-7766, www.epson.com) has unveiled the USB **Epson Stylus Color 740**, which sells for \$280 street. The four-color ink jet printer, which has a maximum resolution of 1,440 by 720 dots per inch, prints at 6 pages per minute in black and 5 ppm in color. The unit supports a variety of media, including transparencies and iron-ons, and is compatible with both PCs and Macs. Epson offers a one-year overnight-exchange warranty with the printer.—Josh Levy

VOICE RECOGNITION

Speech-Dictation Modules

As voice-recognition software continues to improve, new speech-dictation products are coming to market that work in tandem with the software to bring this technology to a wider audience. Whether you're a business traveler on the go or an office worker with too many documents to create, here are some new ways of dramatically cutting your typing time.

Norcom Electronics Corp. offers the **Norcom Model 2500**, a hand-held tape dictation machine (203-374-1500, www.norcom-electronics.com). A two-piece solution, it consists of a hand-held minicassette recorder (\$369 list) and an SRC-1 coupler that links the recorder to your PC (\$99 list).

The machine is simple to use: Just speak freely into the minicassette recorder, then play it back with the coupler attached to your PC's audio ports. Your words will be automatically converted into text using IBM's ViaVoice software. A \$499 version is also available that includes ViaVoice.

Dictaphone Corp. (888-483-6266, www.dictaphone.com) now

sells the **Dictaphone Boomerang 2.0**, a \$349 microphone-with-software solution that also uses IBM's ViaVoice to con-

vert spoken words into document text. As with the Norcom unit, the Boomerang lets you store recorded messages before converting them, in this case as WAV files on your hard disk.

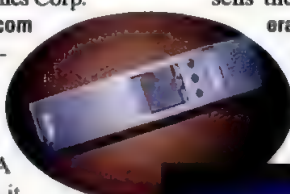
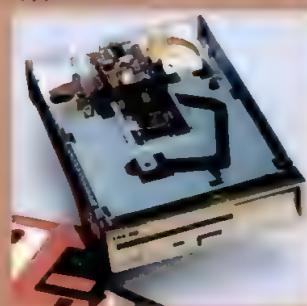
Most dictation solutions require the user's mouth to be less than an inch away from the microphone. Not so with the **Telex Aria Desktop Dictation Microphone**, slated for release late this year from Telex Commu-

nications (800-328-3771, www.computeraudio.telex.com). Eliminating the need for a headset with its acoustic noise-canceling technique, the Aria will let you dictate up to 24 inches away from the microphone (maybe more in a quiet room). The Aria supports all the standard voice-recognition software packages, and Telex plans to price it in line with competing speech-dictation products.—JL

New Superfloppy Contender

Just when you thought there couldn't be any more companies making high-capacity floppy disk drives, Colorado-based Caleb Technology (303-786-9600) announces a new 144MB product to take on the industry Goliaths. As with the 120MB Imation SuperDisk and the 200MB Sony Hi-FD (but not the Imation Zip Drive), the new **Caleb UDH144** drive is backward-compatible with older 3.5-inch floppy disks.

Based on standard hard disk technology, the new drive—which will sell for “well under \$100”—is purportedly faster and cheaper than Imation's 120MB SuperDisk, and Caleb plans to target mainstream desktop consumers. It will be available in three versions: internal ATAPI, external parallel-port, and external PCMCIA. As for competition from Sony's much-awaited 200MB HiFD drive, Caleb says it's expecting the Sony entry to be a top performer with a correspondingly high price—and therefore a notch above its own budget-minded mainstream audience.—JL



NEW VOICES:
Dictaphone and Telex (right) are listening.



WEB PROGRAMMING

The Dirt on SOAP

The main goal of the movement forming behind the programming metalanguage XML (eXtensible Markup Language) is to make other aspects of computing more open. Usually, XML-based standards relate to data, but a new initiative is making programs more open and accessible than ever before. It's known by various names: Microsoft calls the program XML-SOAP (Simple Object Access Protocol), and UserLand Software refers to it as XML-RPC (Remote Procedure Calling).

B2B Integration Server, from webMethods (www.webmethods.com), is a system for automating business-to-business transactions over the Internet. It lets you use XML-RPC as a standardized way of talking to other systems. UserLand's (www.scripting.com) **Frontier** can connect to external systems using XML-RPC and can use XML to manage data stored in a proprietary object database. Microsoft Corp. (www.microsoft.com) plans to include SOAP in some of its products but has not yet made any official announcements.

Though they are not quite in synch, the companies involved have come to an informal understanding that a common standard is in everyone's best interest. UserLand and webMethods speak openly of their efforts on their Web pages; Microsoft refuses to talk about its efforts until the company is closer to shipping products. A fourth company, DataChannel, has a different implementation in its **WebBroker** but intends to ship a product compatible with SOAP.

RPC, a well-established method with as equally established standards, lets one program make a call to a subroutine in another program running on another computer on a network. The standard for such calls is DCE-RPC, as controlled by the Distributed Computing Environment defined

by The Open Group (www.camb.opengroup.org/tech/dce/index.html). It's an open standard, but you need to be a serious programmer in order to use it.

XML-RPC defines the interface to such a call in XML, opening the program for the whole world to see. This has distinct advantages. An example on the webMethods site shows the FedEx package tracking Web page tunneled within an XML-RPC. Internally, the routine is a CGI process,

but the user doesn't need to know any of the details of implementation, which could be a normal RPC, a Unix daemon process, or a Windows NT service.

From UserLand's point of view, as a company that makes scripting tools, XML-RPC opens up an infinite variety of programs to scripting tools that can interface with them in a single, standardized way. Taking another stance is Microsoft, for whom XML-SOAP is a way to make COM and DCOM programs more interoperable with the rest of the world. It also makes Microsoft NT's COM-based services, such as Microsoft Transaction Server and Microsoft

Message Queue Server, more accessible. Whereas XML-SOAP doesn't solve all interoperability problems, it does offer a common vocabulary for creating solutions. For more on XML, see the feature "Why XML Matters" in this issue.—Larry Seltzer

ONLINE SPORTS

Fantasize About Football

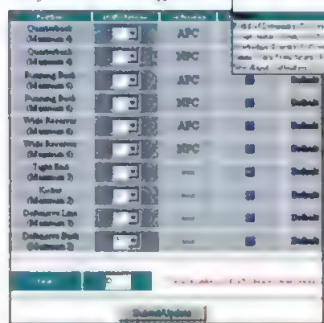
If you've ever been sitting on your couch, beer in hand, and criticized your favorite NFL team for making a dumb trade or a bad draft pick, perhaps it's time for you to consider getting your own online fantasy football team. In fantasy football you make all the decisions. Your team's success or failure is all on you.

Yahoo! Sports Fantasy Football (sports.yahoo.com) is a free service that lets you set up your own

scoring system that rewards every play on the field. In addition, you can receive stat reports and breakdowns on every game.

USA Today has licensed **Owner's Box** (football.theownersbox.com), a free online community for fantasy sports enthusiasts. The site's six areas—Stats & Information, Team Tracker, InstaLeague, Sports Forum, Press Box, and Commissioner Products—give you everything you'll need to track

FIRST DOWN: Draft your favorite players in your own league.



team and compete against other teams. You can set up private leagues with your friends or be part of a randomly generated league. Yahoo! lets you make multiple lineup changes right up to kickoff, and it has a complete

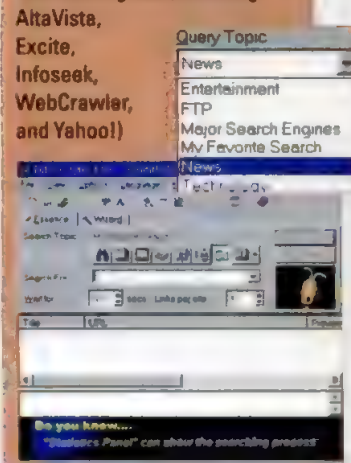
and run your fantasy team. Owner's Box also features Sports Forum, a way to interact with other fantasy football players to get or give advice about running a team. There is a \$50 fee to download statistics for the season.

ESPN Fantasy Football '98 (games-espn.sportszone.com; \$29.95 for your first team) lets you draft your team and gives you the option of forming your own custom league or joining a league made up of "owners" all over the world. You can negotiate trades with other owners using a bulletin board and pick up lesser-known players from the free agent market.—Doug Beizer

More Is Better

Finding what you want on the Web can be a difficult process. Instead of hitting every search engine out there looking for answers, you may want to use Inforian's **Quest 98** (562-802-0986, www.inforian.com/Quest) to do all the work for you.

Quest 98 (\$29.95 list) is a multilingual Internet search tool that simultaneously searches over 200 engines (including AltaVista,



ON A QUEST: Search more than 200 search sites with Quest 98.

and weeds out slow-loading graphics and broken links. During a search, users can view text abstracts of the results and display the text in English, German, French, and Spanish.

The Auto-Update feature adds new or updated search sites automatically, and its Search Wizard guides novices through the query process. Searching by built-in Search Topic, such as Entertainment or Technology, narrows the scope for greater efficiency and relevancy.—Emily Cohan

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AUTHENTICATION

Passwords of the Future

Everyone has forgotten a password at one time or another, but can you forget your thumb? Alternatives to traditional password authentication are coming into their own as prices drop, capabilities expand, and more major vendors are integrating these devices. Here's a look at some new solutions using biometrics and smart cards.

Smart card pioneer ActivCard (650-654-1700, www.activcard.com) is offering its next-genera-

tion product, **ActivCard Gold** (\$2,000 list, plus \$130 per node). ActivCard Gold's user authentication process emulates the automatic teller experience: Users insert the ActivCard Gold into an ActivCard reader attached to a PC and enter their PIN number.

ActivCard has built its prod-

ucts on the "corporate wallet" metaphor of service access for users. With a single log-in, you can be authenticated for network access, have any data you send from your PC certified, and gain access to additional services, such as automatic digital signatures and encryption.

Compaq Corp. lets your fingers do the talking with the first low-cost, biometric security product for businesses (800-345-1518, www.compaq.com). **Compaq Fingerprint Identification Technology**



WAVE ID: Compaq's biometric security device.

(\$99 per node) is compatible with Compaq Deskpro and Armada PCs and notebooks, and replaces user passwords with thumbprints on Windows 95 and NT Desktop clients. The mouse-size Fingerprint Reader connects to the client PC's parallel port and mouse or keyboard port with a pass-through adapter. You can put your thumb on the Reader, and if your print matches the one on file, you are logged on.

For the ultimate in hands-off authentication, look to First Access's (972-4-840-3399, www.access1.com) **First Access Enterprise** (\$189 per seat). Enterprise is the first networkwide proximity authentication product for Windows 95 and NT. Proximity authentication means that there is no physical authentication: If you're within a specified area, you are logged on. Each client PC gets a First Access Sensor and each user a First Access Card. When users approach the workstation with their Card, the First Access Server automatically detects them and logs them on. When a user leaves the area, the Server disables the PC. The First Access Server controls authentication from an NT server, and administrators manage the server locally or over the network with First Access Manager.—Michael N. Rusignuolo

NETWORK MANAGEMENT

Management's Next Wave

Network management is turning to the Web. The current trend is toward standards-based, end-to-end management solutions accessible through a browser. Yet these products must also integrate with existing enterprise management products such as HP Open View, CA Unicenter, or Tivoli. The ideal

are handled via any PC on the network using the Internet Explorer 4.0 browser. Compaq includes Insight Manager XE with all new Compaq servers.

The key to Insight Manager XE is its tight integration. It allows you to handle all DMI, SNMP, and Web-managed products from a single console, and plugs into existing enterprise management platforms. This means you can manage nearly anything on your network through one interface, whether it's a managed switch or a desktop PC. You'll get an even deeper level of detail and control over Compaq equipment that's running Compaq Management Agents.

Insight Manager XE has two components: Management Services provides auto-discovery of devices, central data archiving, alert setup, and administrative authentication. System Manager delivers real-time data on managed systems, event notification, and the ability to perform remote management operations.

Hewlett-Packard is expanding its HP TopTools management line with **TopTools For Hubs & Switches**, which comes bundled free with all

new HP managed hubs and switches. You can use TopTools just for managing network devices or incorporate it with enterprise-wide management packages.

Because TopTools For Hubs & Switches is browser-based, you can monitor your network devices from any PC. The software can monitor traffic on up to 1,500 segments simultaneously and can administer any standards-based hubs or switches. TopTools gives you graphical, real-time reporting and alerting on your network devices. There's even a network performance advisor that analyzes your network and suggests ways to improve performance.—MNR



TRAFFIC GAUGE: Monitor network traffic with HP's TopTools for Hubs & Switches.

of simple, integrated network management software comes closer to reality with new releases from Compaq (800-345-1518, www.compaq.com) and Hewlett-Packard (800-533-1333, www.hp.com).

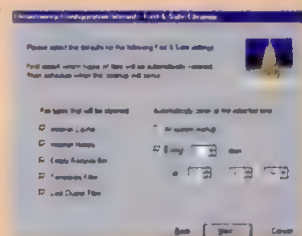
Compaq aims to provide a single management package that fits organizations of all sizes with its **Insight Manager XE**. The software is the first product available that complies with the Web-Based Enterprise Management (WBEM) standard; all management tasks

Enterprise Eraser

Network administrators have always had to trust users to delete old files cluttering their networked PCs. Quarterdeck Corp. (800-683-6696, www.quarterdeck.com), maker of CleanSweep Deluxe, changes this with **CleanSweep for Administrators**

(\$250 per 25 seats). This uninstaller makes sure that useless files are cleared regularly while preventing users from deleting critical files. This cleanup program gives administrators the unique ability to create customized clients for users of different skills levels and even automate the entire process.

The Windows NT-based CleanSweep shares components with the personal version, such as Internet Sweep Technology. Internet Sweep enables safe removal of cookies, plug-ins, and ActiveX controls, plus automatic cleaning of browser caches. New network-specific features include the Configuration Wizard, which walks you through network installation, and the Configuration Editor, which lets you modify client configurations for either whole networks or individual clients.—Carol Mangis





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VisionMaster 501 (18.5" VIS)	TCO '95	0.27mm/dp	96kHz	1600 x 1200@75Hz	\$999
18" VisionMaster 450 (16.0" VIS)	TCO '95	0.26mm/dp	102kHz	1600 x 1200@80Hz	\$699
17" VisionMaster Pro 400 (16.0" VIS)	TCO '95	0.25mm/AG	96kHz	1600 x 1200@75Hz	\$529
VisionMaster 400 (16.0" VIS)	TCO '95	0.26mm/dp	96kHz	1600 x 1200@75Hz	\$489
15" VisionMaster 350 (13.7" VIS)	MPR-II	0.28mm/dp	69kHz	1280 x 1024@85Hz	\$248



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January 6, 1998
VisionMaster Pro 17



Perfect Five-Star Rating
January 1998
VisionMaster 450
VisionMaster Pro 500



Perfect Five-Star Rating
November 1997
VisionMaster Pro 17



Performance & Technical Excellence
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Six Time Winner
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April 1997 May 1997 June 1997
VisionMaster Pro 21



October 7, 1997
VisionMaster Pro 17



March 1997
VisionMaster Pro 21



Eight Time Winner
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July 1997, Sept 1997, Jan 1998, May 1998
VisionMaster Pro 17
April 1998, August 1998
VisionMaster 450

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First Looks

450 MHz...

...on the Corporate Desktop

Intel ups the speed limit of its Pentium II CPU to 450 MHz. PC Labs tests six of the first systems out of the gate, all of which are geared for the corporate LAN.

By Carol Venezia

So you want to buy a fleet of new, highly manageable, LAN-savvy PCs with enough horsepower to carry you through the next few years? Are you anticipating a need for speed and power with Windows NT 5 right around the corner? How about a 450-MHz Pentium II? According to our testing, you get a 15 percent performance boost over a 400-MHz PII corporate system (see "Managed PCs" in our issue of June 30, 1998), as measured by our ZD High-End Winstone 98 test.

But if you're a typical corporate buyer, you're concerned with a whole lot more than speeds and feeds. Let's face it: That part of the PC market has become a commodity. Everyone has access to the same fast CPUs and high-powered graphics boards. That's why, for the six PCs that we tested for this roundup, there's a performance spread of less than 10 percent. And all vendors worth their salt

have DMI 2.0-compliant PCs with Wake on LAN-capable Fast Ethernet adapters. So what's left for a vendor to differentiate itself from the pack?

There is, of course, much more to the 450-MHz corporate PC than just high-flying hardware. Yes, performance matters. If it didn't, you wouldn't buy 450 MHz worth of processor. But perhaps more important, today's buyer must also consider a machine's local and remote system management capabilities, serviceability, expandability/upgradability, system health monitoring, and vendor service and support (the five "abilities").

For this roundup, we gathered six corporate-focused PCs from six vendors: the Compaq Deskpro EN Series, Model 6450X/1400/CDS; Dell OptiPlex GX1p; Gateway E-Series 3200; HP Vectra VL Series 8; IBM PC 300GL; and Micron ClientPro CP 450. Each had Windows NT 4.0, 128MB of RAM, and a Wake on LAN Fast

Ethernet adapter, and each ran through our High-End suite of benchmark tests. But when the testing dust settled, then came the hard part.

FROM YOUR POINT OF VIEW

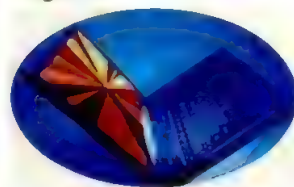
For this story, we did things a bit differently. We asked each of the vendors to tell us—in very specific detail—why we should buy their systems. We became *you* and requested each vendor to treat us like a potential large-volume customer.

We called upon vendors to provide information—sample RFQs, white papers, customer testimonials, Web sites, and the like—that they would give to potential customers. We also asked them to provide details on what sets their PCs and their companies apart from the rest, in terms of the five abilities mentioned above. The analysis that follows is based partly upon this information.

Of the six vendors here, Compaq provided us with the most

INSIDE

SPEED RAMP: PC Labs tests the new 300-MHz Pentium II notebooks, which are sure to please any serious road warrior. *Page 52.*



GET YOUR RAM NOW:

Take a peek at the very first PC-DVD RAM kit on the market, the Creative PC-DVD RAM, which may turn out to be the only optical drive you'll need. *Page 68.*



PORN BLOCKER:

To find out how to ensure your users' e-mail is nothing to be ashamed of, see our review of URLabs Mail-Gear 1.0. *Page 74.*



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First Looks

complete information set that a buyer would need to make a purchase decision for a large corporation. The Deskpro was also our performance and features leader, and its pricing was extremely competitive. For all of these reasons, the Compaq Deskpro EN Series, Model 6450X/1400/CDS is our Editors' Choice.

What follows is a head-to-head competition, based on our five abilities criteria. You'll find out which of the vendors is doing what best, which one is lagging behind, and how each stacks up relative to the others. Our goal is to provide you with one-stop solutions shopping.

Local and Remote Management

The most difficult corporate PC feature to rate is manageability. Ever since that famous Gartner Group study, *everyone* knows what TCO stands for, and every PC vendor claims to lower it in some way with its products and services.

All of the PCs here are manageable to some degree: All are DMI 2.0- and Wired for Management-compliant, and all have software bundles that enable them to be managed over a LAN. To evaluate each vendor's

offering, we were most concerned with how manageable the system was, regardless of the environment to which it would be hooked up.

Both Gateway and Micron bundle Intel's LANdesk Client Manager, Version 3.3. Neither vendor provides additional system-specific software agents for its machines, so whatever LANdesk plugs into is what you get. Intel currently has LDCM console application integration modules for HP's OpenView Network Node Manager, Tivoli TME, and CA Unicenter.

When we get to "the big four," things get a bit more involved. Each PC has its own manageability solution, which ties closely to other product-line offerings. By name, these solutions are Compaq Intelligent Manageability, Dell OpenManage, and HP TopTools; IBM doesn't have a specific umbrella term.

For these four, it's virtually impossible to rate them on a best-to-worst scale: All are standards-driving industry leaders that provide highly manageable solutions. For this discussion, we feel that it's most productive to focus on the unique offerings of each company. This way, you can decide which vendor provides the best solution for *your* business needs.

No matter whose enterprise-level management tool you're using (be it CA Unicenter TNG, Tivoli TME 10, or HP OpenView) you can plug in a Compaq Deskpro and know that it will be recognized and managed as a Deskpro. This is important if you're operating in a heterogeneous environment, but you still want to take advantage of the extra features that Compaq builds into its products.

Compaq is also leading the industry charge to implement WBEM, or Web-Based Enterprise Management. In August, the vendor introduced Insight Manager XE 1.0, which allows you to manage devices using a standard Web browser. Through Insight Manager XE 1.0, you can manage your Compaq hardware in real time, and you can monitor non-Compaq systems, no matter what protocol they use. Initial IM XE rollout is controlled; for details, see Compaq's Web site. Compaq also recently introduced its Fingerprint Identification Technology, which enables you (for \$99 per seat) to equip systems with a fingerprint scanner and software to address the issue of network security.

Dell's OpenManage is tightly focused on open standards to ensure that Dell products are

good corporate citizens that are compatible with major management tools. To that end, Dell has in place a compatibility partnership program—under which the company tests its products for interoperability with numerous other vendors' tools and apps. Currently, Dell has Optiplex-specific agents for both OpenView and Tivoli (but not Unicenter).

Hewlett-Packard, like Compaq, is an early leader in Web-based management. Through its OpenView Desktop Administrator and Web-based TopTools, you can manage both HP and non-HP PCs (as well as a laundry list of other devices—including palmtops, printers, hubs, and servers) from anywhere, at any time, on any system with a browser. Also with these tools, you can distribute software, check year 2000 compliance, and remotely update and install drivers and BIOSs. HP systems integrate into both HP OpenView and CA Unicenter, but not Tivoli TME.

The most innovative new offering in IBM's management lineup is UMA, its Universal Management Agent for browser-based client management. Through this agent—and customization in some cases—you can plug IBM PCs into anyone's management platform and manage them. This program is relatively new, so look for future plug-in developments from IBM and from third-party solutions providers.

IBM also recently introduced Asset ID, a radio-frequency technology to simplify PC deployment. Available on select IBM PCs, the Asset ID system is comprised of an antenna in the PC, an EEPROM

Compaq
Deskpro EN
Series, Model
6450X/1400/CDS
Street price: \$2,910
Compaq Computer Corp.
800-888-0220, 281-529-0671
www.compaq.com

FEATURES AND PERFORMANCE

Pentium II/450 Corporate PCs

	Price (including 17- inch monitor)	Hard disk	Graphics adapter/RAM	CD-ROM drive speed	Network adapter	ZD High-End Winstone 98 (High scores are best)
Compaq Deskpro EN Series, Model 6450X/1400/CDS	\$2,910 street	14GB Ultra ATA	Matrox Millennium G200 AGP / 8MB	32X	Compaq Fast Ethernet 10/100 NIC with Remote Wakeup	45.7
Dell OptiPlex GX1p	\$3,202 direct	14.4GB ATA-4	Integrated ATI Rage Pro Turbo 2X AGP / 8MB	40X	Integrated 3Com 10/100 with Wake on LAN	43.0
Gateway E-Series 3200	\$2,043 direct	10GB Ultra ATA	Integrated ATI Rage Pro Turbo 2X AGP / 4MB	32X	Integrated 3Com Fast EtherLink XL	43.4
HP Vectra VL Series 8	\$2,780 street	10.1GB Ultra ATA	Integrated Matrox Productiva G-100 AGP / 4MB	32X	3Com 10/100 Fast EtherLink XL	43.6
IBM PC 300GL	\$2,950 street	9.1GB Ultra ATA	Matrox Millennium G200 AGP / 8MB	32X	Integrated 10/100 Ethernet with Wake on LAN	44.0
Micron ClientPro CP 450	\$2,299 direct	6.4GB ATA-4	Integrated nVidia Riva 128 / 4MB	32X	3Com Fast Ether- Link XL PCI	41.6

Dell OptiPlex GX1p

Direct price: \$3,202

Dell Computer Corp.,

800-998-3355, 512-338-4400

www.dell.com

404 at www.pcmag.com/info/links

easily removed by simply raising a lever. We also liked the PCI slot setup: A metal plate secures all cards in place, replacing individual screws for each card.

Compaq's Deskpro also features an expansion card cage and motherboard that slide out easily via levers. Another convenient feature

with system information burned in (including serial numbers), and an RF-enabled hand-held device (available through third parties). With this system, you can take inventory of new PCs before they're unboxed, deploy them to the proper location, plug them into the network, and then use IBM's LANClient Control Manager software and the PC's Wake on LAN NIC to download the correct software image.

System Serviceability

Servicing PCs isn't simply a matter of deploying some guy with a screwdriver, because time is money for corporations. So if PC vendors make it easier for their customers to get in and out machines and to switch parts out quickly, the more their customers save in labor costs.

Most of our participants did well in this category. But Compaq and HP stand slightly above the others. Both provide tool-free entry: Just flip a couple of latches and the cover comes right off (desktop machine for Compaq, mini-tower for HP). HP's expansion-slot riser card and motherboard are both

of the Deskpro is its drive cage. You don't have to take any screws out to remove drives; just pull up on a green plastic tab and the installed device slides out the front of the case.

We were impressed by Dell's OptiFrame chassis. It's easy to get into: Just push a button on the front of the mini-tower and the side panel comes off. The expansion card cage is also easy to remove with the flip of a lever. Getting the motherboard out requires screw removal, but it's easily done. We also liked the drive-cage configuration: The power supply swings up for access to the bays, and all devices mounted in those bays are secured on rails, so they slide out the front of the case easily.

Gateway and IBM's desktop chassis also provide tool-free entry and motherboard removal. To perform the latter

function on each one, you must first remove one side of the chassis. For IBM, this function requires a screwdriver; for Gateway, it doesn't. The IBM unit's PCI cards are secured via a two-screw metal plate; also on the plus side, there's a road map with jumper and memory settings inside the case cover. On the downside, we found sharp edges inside the cover that caused a cut finger and a snagged sweater. We were pleasantly surprised by Gateway's E-Series desktop unit, with its snap-in hard disk, slide-

out drives, and tool-free PCI slots.

Micron, unfortunately, falls behind its competitors on serviceability. The company has switched to a microtower case; to access its interior, you must remove two recessed, noncapable (easy to lose) screws from the side panel and then slide the cover off. There's very little clearance between the power supply and drive cage for device addition or removal, and the motherboard is screwed down, so it's not easily removed.

Editors' Choice

• Compaq Deskpro EN Series, Model 6450X/1400/CDS



A 450-MHz, corporate-focused, manageable PC has a tough job ahead of it: It must be fast, flexi-

ble, serviceable, easy to manage regardless of your environment, and backed by world-class support. Our Editors' Choice in this round-

up—the Compaq Deskpro EN Series, Model 6450/1400/CDS (\$2,910 street)—ably meets this challenge.

The Deskpro used leading-edge hardware—including a 14GB Ultra ATA hard disk and an 8MB Matrox Millennium G200 graphics card—to produce the top ZD High-End and Business Winstone benchmark scores of this roundup. And the vast array of tools and services that Compaq provides with this machine via its Intelligent Manageability solution ensures that the Deskpro will be asset to your network, regardless of whose tools you use to run it.

HP Vectra VL Series 8

Street price: \$2,780

Hewlett-Packard Co.,

800-322-4772,

415-657-1981

www.hp.com/vectra

401 at www.pcmag.com/info/links

Gateway E-Series 3200

Direct price: \$2,043

Gateway

800-848-2800, 605-232-2000

www.gateway.com

400 at www.pcmag.com/info/links

Expandability/Upgradability

Like serviceability, we found varying degrees of expandability—open slots and bays, free IRQs, and the like—with these PCs. As you'd expect, in most cases, it was a function of the type of chassis used.

For actual physical expansion space, the Dell OptiPlex GX1p mini-tower comes out on top. Partly due to its integrated graphics and Fast Ethernet chip sets, all slots are open, which in-

First Looks

clude three PCI slots, two ISA, and two shared. There are also three empty drive bays for device expansion. HP runs an extremely close second on this count, coming up just one PCI slot short of the top spot.

Compaq, Gateway, and IBM all offer approximately the same amount of expansion in their systems' desktop chassis. Each has three DIMM sockets and an open 5.25-inch bay up front. IBM offers a tad more in the slot department, with four possibilities instead of the other vendors' three. Micron's ClientPro offers the least expansion space of all, with only two DIMM sockets and two available slots.

Another feature that we looked at was availability of IRQs. The good news is that with these products, you've got plenty. As tested, the IBM PC had five open, Micron had seven, and the remaining four systems had six.

System Health Monitoring

If you could monitor your health as well as these PCs can, you'd never get sick. With Dell, Gateway, IBM, and Micron, you get the full boat of component monitoring functions, including temperatures, voltages, fan speeds, and chassis intrusion detection. All six companies use SMART hard disks that are capable of sending impending failure alerts over the network.

Compaq goes beyond the basics to the level of fault notification and recovery. The Deskpro EN series provides fault prediction and prefailure warranties (in other words, you get the notification, you send the part back for a new one) for ECC memory, SMART II hard disks, and Pentium II CPUs. With the appropriate third-party software, Deskpros can perform

proactive hard disk backup to either a local or remote source.

Like Compaq, Dell also uses SMART II hard disks in its OptiPlex units. The hard disks have the capability of providing

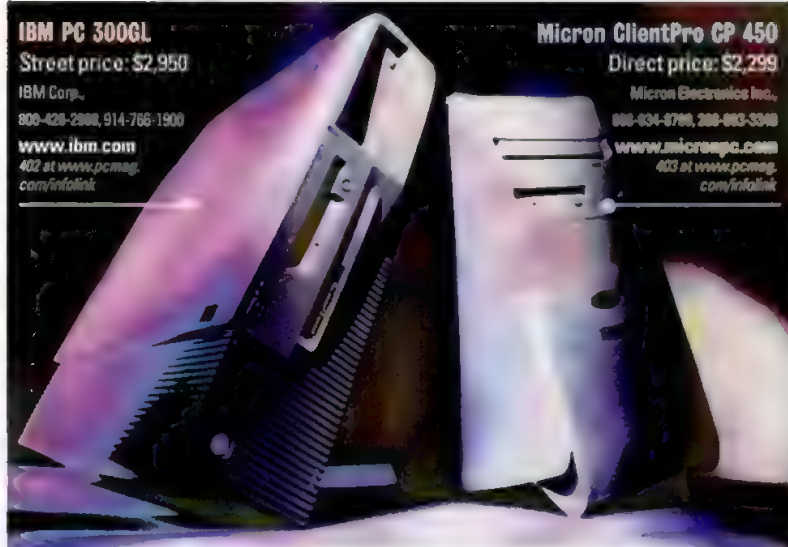
sion, if there are POST configuration or system errors, or in the event of OS errors or crashes. IBM also offers its SMART Reaction software, which automatically backs up a user's hard disk

doing to beef up their service and support offerings? In part, they're going to the Web. Compaq, Dell, HP, and IBM stand out online: All provide an exhaustive amount of information—including software and driver updates, patches, and fixes for specific machines; thousands of pages of technical documentation; and even the ability to send e-mail directly to technical support. These four vendors stand out because they provide the best *system-specific* information.

Compaq has a great service called Info Messenger. Just go to Compaq's Web site, register for the service, and when there's new information on your Compaq hardware, you'll receive notification via e-mail.

Dell has significantly enhanced its warranty and service offerings for OptiPlex family in general, and the GX1p specifically. The vendor's warranty now covers both parts and labor for three years; previously, labor was covered for one year. Also, with the GX1p, you can purchase one year of Windows NT Workstation support (\$199). Online, Dell offers Internet Premier Pages for its major account customers. These pages provide secure access to customer-specific information, including order tracking and product-specific technical support.

At IBM's Web site, you can fill out a product profile, and IBM will build a customized support page that is specific to your hardware. Through this page, you'll get access to IBM's Knowledge Base, answers to FAQs about your specific hardware, information on parts, and technical tips and downloadables. Like Compaq, IBM offers a proactive e-mail option to deliver personalized information. **PC**



IBM PC 300GL
Street price: \$2,950
IBM Corp.,
800-428-2988, 914-766-1900
www.ibm.com
402 at www.pcmag.com/infolink

Micron ClientPro CP 450
Direct price: \$2,299
Micron Electronics Inc.,
800-634-5788, 202-893-3340
www.micronpc.com
403 at www.pcmag.com/infolink

predictive failure alerts, and you can configure the PC so when a failure alert is triggered, an automated network backup is performed. Fault alert and correction of ECC RAM is also supported, so the OptiPlex can recover from single-bit errors and can send notification via the network of double-bit failures. If an ECC DIMM fails, the system will automatically remap around it.

HP Vectras each have a unique feature called HP Safe-Off, which prevents data loss if a user inadvertently switches the PC off. If you do hit the power switch when the machine is on, the system will beep and then remind you to save your data. When the data has been saved, the PC will perform a clean shutdown and then shut itself off.

An innovative part of both IBM's and Gateway's solutions is Alert on LAN. Through the hardware monitoring ASICs and software such as LANDesk 3.3, alerts will be sent to the management console if the PC is disconnected from the network, if there's a chassis intru-

sion to the server if a drive failure alert happens.

Vendor Service and Support

Just as with manageability, vendor service and support is extremely difficult to rate. Each vendor offers at least a three-year warranty with at least one year of on-site service, as well as around-the-clock telephone technical support.

The best measure that we have of service and support is our annual reader survey of Service & Reliability. This survey asks our readers to rate their desktop PCs in four categories: Satisfaction with reliability, repair, and technical support, as well as whether their PC needed repairs in the previous 12 months. Each vendor is given a letter grade based upon the results; to earn an "A," all four results must be significantly better than average. On our most recent survey, Dell, HP, and IBM received grades of A; Compaq, Gateway, and Micron received grades of B.

So what else are these vendors

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any other computer company.
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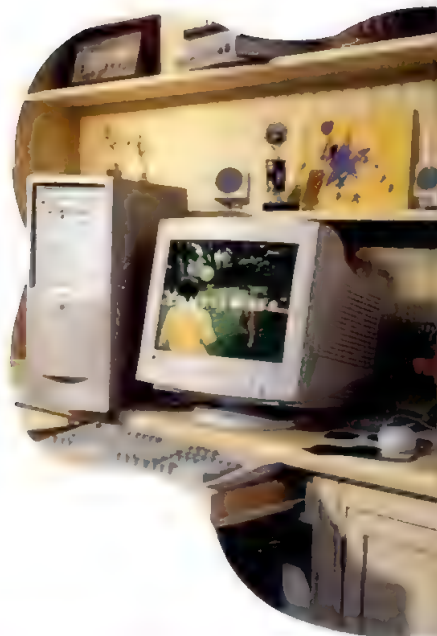


Let's talk about a better way to buy and own a computer.



Let's talk about loyalty. Three out of every four Gateway customers came back to Gateway last year.¹ No other computer company has fans so loyal. Why? Because we offer award-winning products at great prices, backed by unbeatable customer service and support. And to make buying and owning a computer even easier, we've come up with the Your:)WareSM program.²

With Your:)Ware, you buy a new GatewayTM PC with no money down, making monthly payments starting as low as \$49.95 a month for 48 months³—we build it just for you, with optional unlimited Internet access³. Best of all, you can stay on top of new technology, because after two years, you have the option to trade in your Gateway PC toward the purchase of a new one. Once you buy your first Gateway computer, you're a believer.



Introducing Your:)Ware.



Customized Hardware

With Your:)Ware you get to choose exactly what you want. And that's not even the best part.



Obsolescence Protection

The computer you build today will still be useful tomorrow because you have the option to trade it in toward the purchase of a new one in two years.



Internet Access

Convenient access to the World Wide Web is just a few clicks away on a PC that's specifically built to handle it. And with the Your:)Ware program, you can get unlimited Internet access*. Can we help you with anything else?



The Right Software

It doesn't matter if it's for a family of six; we can build a PC with software that's perfect for everyone. Tell us who's going to use it and for what purpose, so we can put together a system that fits their specific needs.



Service

After all that, you have to ask? Gateway Gold™ Service for G-Series PCs means you'll get quality service 24 hours a day, 7 days a week from the time we help you build your PC, on through the life of your computer.**



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Intel® Celeron™ Processor 333MHz with 128K Cache

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for 48 mos or \$1259*

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Gateway™

*Prices do not include shipping and handling or any applicable taxes. Loan financing available on approved credit through independent lender. Payments based on 48 month term and an Annual Percentage Rate as low as 14.9%. Your APR may be higher. 2% access fee (k fee) (\$2/min/\$15 max) not applicable to Gateway purchases. Cash price does not include Internet access.

** Gateway Gold on-site and installation services are administered by PC Technology Services, Inc. for product (excluding mice, keyboards, monitors and Solo portables) purchased and located in the continental United States, Alaska, Hawaii, Puerto Rico and Canada.

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How can you keep up with the speed of new technology? Easy. Buy from the company that gives you the hottest stuff out there. Our G6-400 won the **Editor's Choice Award** from the May '98 *PC Magazine* and our G-Series won the **1998 World Class Award** from *PC World*. Not bad, but we also just came out with the G6-450, featuring the fastest Pentium® II processor yet. Let us design a system personalized just for you. And with the Your:)WareSM program, you can ride the wave of innovation with the option of trading in your GatewayTM PC after two years toward the purchase of a new one.* We call it obsolescence protection. Another reason technology buffs keep coming back to Gateway.





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Every Gateway client is unique, and so is every Gateway PC. The systems here are just examples of what we can build for you.

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-  Intel® Pentium II Processor 400MHz with 512K Cache
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- EV700 .28 Screen Pitch 17" Monitor (15.9" viewable)
- 8MB AGP Graphics Accelerator
- 10GB Ultra ATA Hard Drive
- DVD-ROM Drive & MPEG2 Decoder
- SoundBlaster® AudioPCI™ 64V
- Boston Acoustics® BA635™ Speakers
- U.S. Robotics® 56K* Voice Winmodem
- Mid-Tower Case
- MultiFunction Keyboard & MS® IntelliMouse®
-  Microsoft® Windows® 98 & MS Home Essentials™ Software
-  Gateway Gold™ Service** for G-Series PCs
-  As low as **\$56/mo.** for 48 mos. or **\$1999***

Scary G6-450

-  Intel Pentium II Processor 450MHz with 512K Cache
- 128MB SDRAM
- VX900 .26 Screen Pitch 19" Monitor (18" viewable)
- 8MB AGP Graphics Accelerator
- 10GB Ultra ATA Hard Drive
- DVD-ROM Drive & MPEG2 Decoder
- SoundBlaster® AudioPCI 64V
- Boston Acoustics BA635 Speakers
- U.S. Robotics 56K* Voice Winmodem
- Mid-Tower Case
- MultiFunction Keyboard & MS IntelliMouse
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The Capacity To Do More™ with your PC. It's today's standard in high-capacity removable storage. Exchange and carry your files anywhere. Organize and protect more of your stuff.

gateway.netSM \$14.95/mo.³

The Screamer

G6-450XL

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- 8MB AGP Graphics Accelerator
- 12MB 3Dfx™ Voodoo2 3-D Accelerator & Extreme Gaming Software
- TV/FM Tuner Card
- 16GB Ultra ATA Hard Drive
- DVD-ROM Drive & MPEG2 Decoder
- Philips CD-RW CD-Rewritable Drive
- SoundBlaster AudioPCI 64V
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- U.S. Robotics 56K* Voice Winmodem
- Tower Case
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Let's talk about home economics.



People who buy Gateway™ PCs for their home say they want a computer that does everything — including fit into their budget. We can do the same for you. Our G-Series was recently named **Best Home Desktop PC**, receiving the **World Class Award** from the July '98 *PC World*. The G6-400, **pentium® II** in fact, was rated **WinList Fastest Performer** by the May to September '98 *Windows Magazine*. We'll take the system you choose and load it up with all the hardware and software your family needs. Including Internet access,³ and flexible service and support 24 hours a day, seven days a week. Plus, with the Your:~WareSM program,² you have the option of trading in your Gateway PC toward the purchase of a new one in two years. That's a home improvement anyone can make.





Get more bang for your buck

Every Gateway client is unique, and so is every Gateway PC. The systems here are just examples of what we can build for you.

Family Friend G6-333C

-  Intel® Celeron™ Processor 333MHz with 128K Cache
- 32MB SDRAM
- EV700 .28 Screen Pitch 17" Monitor (15.9" viewable)
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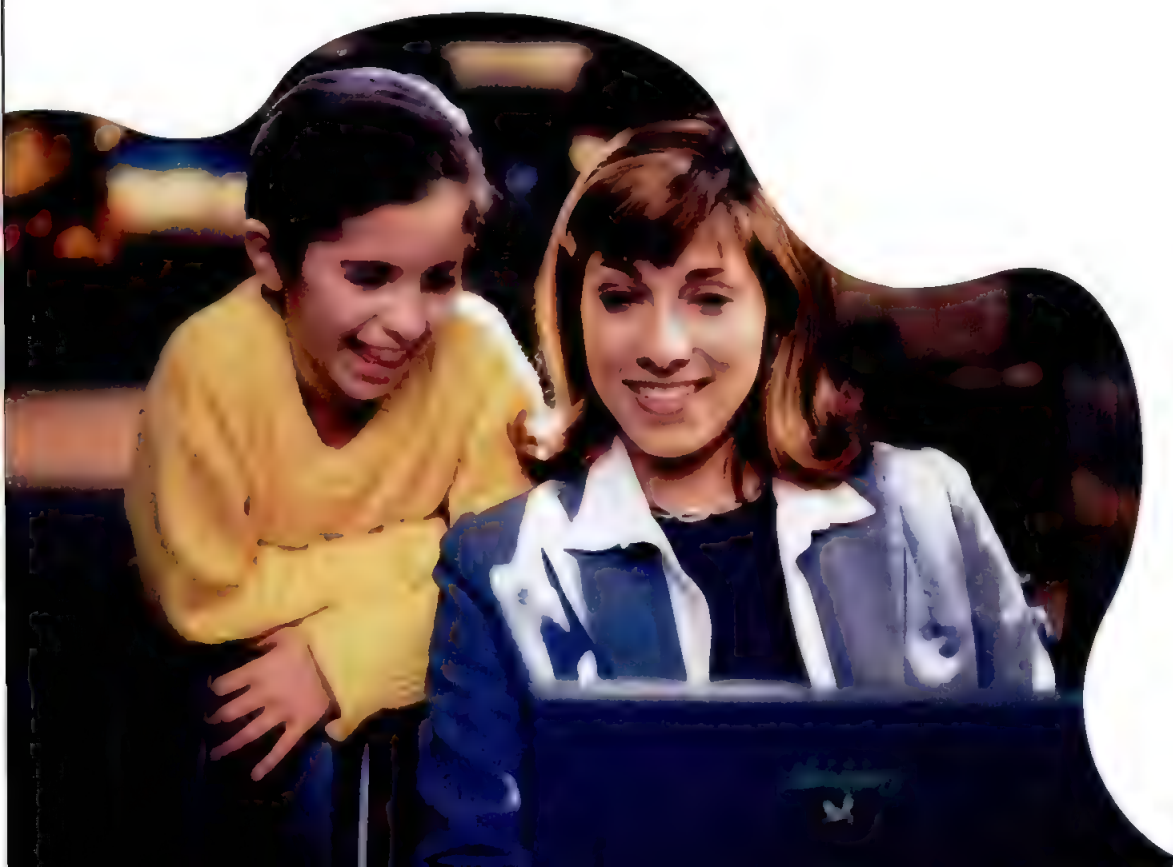
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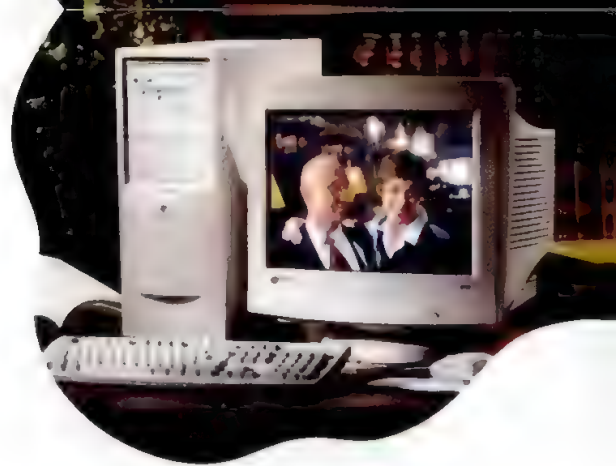
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8MB AGP Graphics Accelerator
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13X min/32X max CD-ROM Drive
Mid-Tower Case
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Let's talk about working on a presentation at 3 a.m. with technical support standing by.



pentium II

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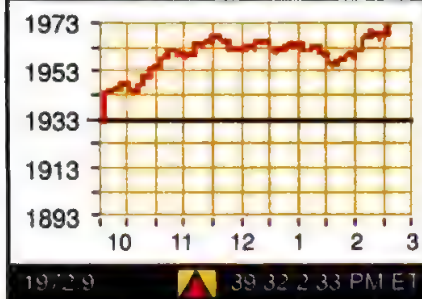
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Tech Index



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ALEX			
Symbol	Price	Change	
NKE	45 7/8	+1/4	
DIS	35 3/16	-3/16	
ORCL	26 3/4	+1/8	
HNZ	55 5/8	-1/4	
JNJ	78 15/16	+1/2	

Most Actives			
Sym	Price	Chg	Vol(000)
PG	80 1/16	-39/16	6413600
BA	39 1/16	-1/16	5663500
MU	32 5/8	17/16	5612300
I	60 5/8	-11/16	5108300

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First Looks

NOTEBOOK PCs

300 MHz to Go

Intel kicks up the speed of its Mobile Pentium II to 300 MHz for the power-hungry road warrior.

By Melissa J. Perenson and Carol Venezia

If you place yourself firmly in the "just gotta have the most speed available" category for notebook PCs, you'll definitely be interested in the latest speed bump on the Intel road map of mobile processors. The 300-MHz mobile Pentium II—announced in September—may appear to be just a slight tick up the clock scale from the 266-MHz mobile PII. But if about 18 percent better performance on business applications (on the average, as measured by our ZD Business Winstone 98 test) is worth your price of admission, you should check out this new CPU.

For our first look at notebooks with this processor, we gathered four brand-new machines. Over the next three pages, you'll find evaluations of the Compaq Armada 7400 (\$4,200 street), the Dell Inspiron 7000 D300LT (\$3,699 direct), the HP OmniBook 7150 (\$5,000 street), and the Toshiba Tecra 8000 (\$4,400 street). Each has 64MB of RAM, 13.3-inch or larger displays (up to a huge

15.0-inch panel on the Dell Inspiron 7000 D300LT), and at least a 6GB hard disk capacity.

Also for the first time—because you asked for it—we tested these notebooks for 3-D performance with our ZD 3D WinMark 98 benchmark test. Although no 3-D business-oriented applications are on the market (okay, admit it—you just want to play Quake II on the airplane), you nonetheless wanted to know how these mobile machines handle 3-D. You'll be surprised to see just how well some performed.

COMPAQ ARMADA 7400

If you want all the power that the 300-MHz mobile Pentium II has to offer but don't want to lug around 9 to 10 pounds' worth of notebook, check out the Compaq Armada 7400. Housed in an attractive carbon-colored magnesium case, the 7400 offers both a highly flexible

design and great performance, to boot.

The 7400's best feature is its component flexibility. Up front, you'll find the unit's modular MultiBay, which accepts a number of individual options—such as a 24X CD-ROM drive (included in our test configuration), a DVD-ROM drive (a \$489 option), a SuperDisk LS-120 drive (a \$219 option), a floppy disk drive, or a second SMART hard disk.



POWER PACKAGE: The Compaq Armada 7400 has a full-size, pop-up keyboard.

Also at the top of the 7400's exciting features list is its size: In short, it's not your typical huge high-end notebook. In order to keep its 1.5- by 12- by 9.5-inch

(HWD) physique, the keyboard actually recesses into the base when the unit is closed. When you open the notebook, you hear and see the full-size keyboard pop up.

You won't want for power with this notebook. Compaq is one of the first vendors in this market to bring AGP into its notebooks—first with the Armada 7800 series and now in the 7400. The system uses S3's ViRGE/MX graphics accelerator with 4MB of SGRAM, implemented on a 66-MHz AGP bus. This chip set contributed to the 7400's number-two placement on our Winstone test, just 0.2 point behind the chart-topping Dell Inspiron 7000 D300LT. Unfortunately, although the system's ViRGE/MX accelerator does support some

3-D calls in hardware, it performed relatively poorly on our 3D WinMark 98 test. On our BatteryMark test, the system unfortunately clocked the lowest time at 2:39.

The rest of the 7400's components impressively augment its high-powered core. You'll find a 13.3-inch SVGA active-matrix display, 64MB of synchronous DRAM (expandable to 128MB), and a 6.4GB hard disk. To enhance the unit's CD or DVD drive, there are dual speakers to pump out the integrated Compaq PremierSound, plus a headphone, a microphone, and line-in jacks on the right side of the notebook. To connect while on the road or at your desk, there's an integrated 56.6-Kbps modem.

Not surprising, given the com-

FEATURES AND PERFORMANCE

Pentium II/300 Notebooks



These 300-MHz Pentium II notebooks, on the average, delivered 18 percent better performance on our ZD Business Winstone 98 test than the 266-MHz portables we tested for our

August issue. Battery life—as measured by our ZD BatteryMark 2.0 test—varied among these machines, from a low of 2:39 for the Compaq Armada to a high of 3:32 for the HP OmniBook.

	Price	System weight/ Travel weight Pounds	ZD BatteryMark Hours: minutes ▲	ZD Business Winstone 98 Score ▲	ZD 3D WinMark 98 Score ▲
▲ High scores are best					
Bold type denotes first place					
Compaq Armada 7400	\$4,200 street	8.9 / 7.9	2:39	22.4	121
Dell Inspiron 7000 D300LT	\$3,699 direct	9.2 / 10.1	3:09	22.6	755
HP OmniBook 7150	\$5,000 street	9.0 / 9.9	3:32	20.9	596
Toshiba Tecra 8000	\$4,400 street	8.5 / 7.4	2:52	21.6	23
Average 266-MHz notebook, August 1998	\$3,997	7.7 / 8.5	2:56	18.5	N/A

N/A—Not applicable. We did not run this test for our August 1998 roundup.

pany's strong focus on corporate buyers, Compaq preloads its Intelligent Manageability and Insight Management agent software on the Armada, making it highly manageable.

For corporate purchases or even for single users, the Compaq Armada 7400 is an attractive buy.

Compaq Armada 7400. Street price: \$4,200, with 13.3-inch display, 6.4GB hard disk, 24X CD-ROM drive. Compaq Computer Corp., Houston; 800-345-1518, 281-370-0670; www.compaq.com.

DELL INSPIRON 7000 D300LT

Read the spec sheets on the new Dell Inspiron 7000 D300LT and you'll come to the same conclusion we did: This is one Texas-size notebook. From its 15.0-inch display to its record-breaking benchmark test scores, its 8MB graphics subsystem (an industry first), its 8GB, 4,900-rpm hard disk, its 2X DVD-ROM drive—this system redefines the term “desktop replacement.” And more amazing, this entire package is the lowest-priced unit here—at just \$3,699 (direct).

The 7000 led the pack on our benchmark tests, posting 22.6, the highest Winstone score we've seen to date from a notebook. Even more impressive, however, was its 3-D performance: On our 3D WinMark test, this machine racked up a score of 755—believe it or not, that's higher than the majority of 400-MHz Pentium II desktop PCs that we've tested this year.

The major component responsible for this huge score is obviously the graphics subsystem. In this area, the company has broken new ground: The Dell Inspiron 7000 D300LT boasts an ATI Rage LT Pro 2X



SIZE DOES MATTER: The Dell Inspiron 7000 D300LT has a spacious 15-inch display.

AGP graphics accelerator complemented by 8MB of 100-MHz SGRAM. The graphics chip set and memory are located on a removable card, so it can be upgraded.

This subsystem is also responsible for the 7000's high score of 146 on our Graphics WinMark test. And despite its 15.0-inch display (always a big power draw) the system, with its capacious 4,500-mAh lithium pack, still managed to clock an impressive 3 hours 9 minutes on our BatteryMark test.

The only trade-off you'll have to make with this notebook is size: Small it isn't. The machine measures 2 by 12.8 by 10.3 inches (HWD) and weighs in equipped for travel at just over 10 pounds. Its measurements are a bit deceiving, however, because the display housing is actually a bit larger than the body of the notebook; it's almost an inch thick to safeguard such a large and comparatively heavy panel.

The 7000's multimedia components also will not disappoint. We tested a system with a front-mounted 2X DVD-ROM drive that's augmented by an internal MPEG-2/AC3 decoder card; you

can also get a CD-ROM/floppy disk combo drive that fits in this same bay. This notebook also has 3-D surround sound, provided by ESS Technology's Maestro-2 PCI audio accelerator (which supports hardware wavetable). Headphone, microphone, and line-out jacks—as well as a volume-control thumbwheel—are located on the left side of the machine to ensure easy access.

The standard set of ports that you'll find on most notebooks are joined on this machine by a TV-out port, which provides native S-video support. A composite video adapter is also included for use with televisions that don't support S-video. To connect, the 7000 provides an

The Dell Inspiron 7000 D300LT is a rare beast indeed: a no-compromise bargain.

Dell Inspiron 7000 D300LT. Direct price: \$3,699, with 15.0-inch display, 8GB hard disk, 2X DVD-ROM drive. Dell Computer Corp., Round Rock, TX; 800-388-8542, 512-338-4400; www.dell.com; 404 at www.pcmag.com/infolink.

HP OMNIBOOK 7150

Considering the HP OmniBook 7150's hefty 9-pound weight (nearly 10 pounds with the power brick), it's a good thing that the unit packs a lot of functionality into its chassis. The 7150 also posted the longest battery life of our group of four, as well as an impressive showing on our 3D WinMark test.

The 7150 is equipped with 64MB of SDRAM, an 8.2GB hard disk, and a brilliant 14.1-inch XGA TFT display. Other core components include ATI's Rage3D LT 2X AGP graph-



TWO IN ONE: The HP OmniBook 7150 has a combination DVD-ROM and floppy disk drive.

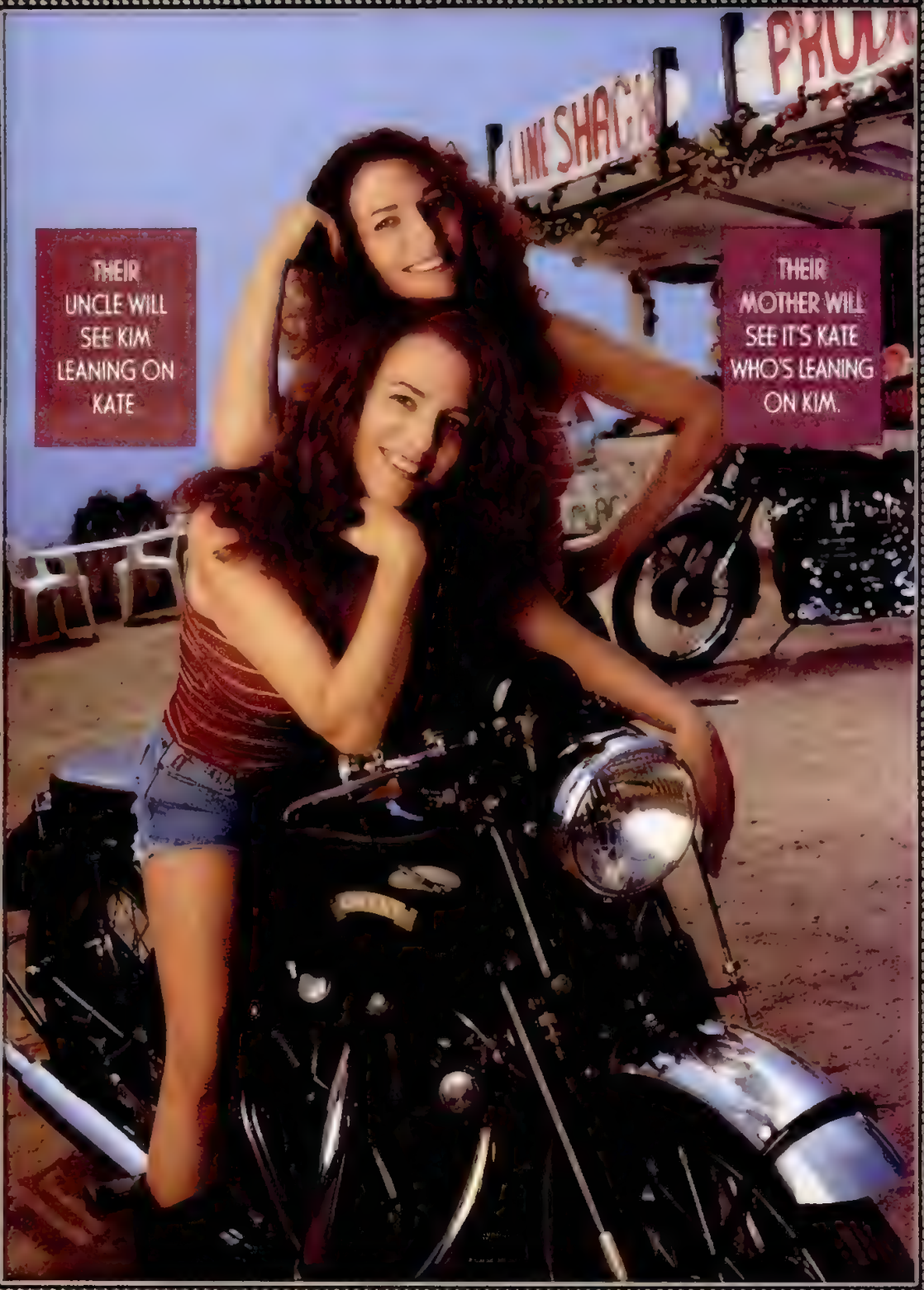
internal DSVD 56.6-Kbps modem. And as you explore this machine, you'll

find that every port, bay, and removable cover is labeled with a small icon, so you know exactly what's supposed to go in what spot. This means no more pulling off multiple doors to find where the memory goes or trying to cram a device into a bay that can't accept it.

ics controller with 100-MHz SGRAM and a combination 2X DVD drive/floppy disk drive module.

The combo drive is located at the front left of the machine in the first of the system's two easily accessible modular bays; to the right is the lithium ion battery. The first bay can also accommodate an LS-120 drive (\$249 list), a second battery, or a second hard disk.

HP has included two pointing



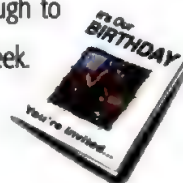
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SEE KIM
LEANING ON
KATE

THEIR
MOTHER WILL
SEE IT'S KATE
WHO'S LEANING
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First Looks

devices with the system. In addition to the integrated pointing stick, a unique four-button touchpad is embedded in the 7150's 4-inch palm rest. The two buttons on top are designed to be used with the pointing stick and are easier, more natural reaches from the pointing stick's position at the center of the keyboard. Unfortunately, unless you disable the pointing stick, the placement of the generously sized touchpad makes it difficult to use the pointing stick without the touchpad getting in the way.

Aside from the usual complement of ports, the unit has a NTSC/PAL video-out, one USB port, and a PS/2 port that supports a Y-adaptor. There's also a system reset button on the right side of the unit and accommodation for the Kensington Microsaver lock. The machine's suspend trigger works after the fashion of your refrigerator's light: As you close the lid, a tiny plastic stick located at the back of the unit is depressed, invoking the suspended state.

The 7150's performance was mixed as compared with the other three 300-MHz systems reviewed here. Although the Business Winstone score was the lowest of the four at 20.9, the unit's other scores were strong. The 7150's Business Graphics Winmark, registered at 143, was the second highest, and its Business Disk WinMark 98 was at 1,080. The smart lithium ion battery showed the longest battery life, lasting 3:32 in our Battery-Mark testing.

Unfortunately, though the DVD drive's quality was generally good, we noticed some skipping and artifacting, particularly

during movie action sequences. And the speakers, which are built into the palm rest, were lacking in sound quality.

Some added conveniences of the HP OmniBook 7150 are the inclusion of both Agaté Technologies' software for supporting hot-swappable modules and the vendor's own HP TopTools 3.0 Desktop Management Inter-

50 ways to leave your lover, but with prices starting as low as \$2,800 (street), there are more than 5,800 ways to configure your Tecra.

The 8000 may be built with ease of qualification in mind for the bean-counting business-suit types, but that doesn't mean it's one of those typical, stripped-down, "corporate-y" notebooks.

price: This Toshiba Tecra 8000 costs just \$4,400 (street).

The unit's modular SelectBay is available with a second battery (\$269 list), an Iomega Zip drive (\$299 list), a Sony LS120 drive (\$249 list), or a DVD drive (\$300 list). Toshiba will be one of the first vendors to market in a notebook when this option ships in October.

On our Winstone 98 test, the 8000 garnered a 21.6, placing about a point behind the Dell and Compaq systems. The 8000's Graphics and Disk WinMark 98 scores, although not at the top of the scores for the four units in this roundup, were also strong at 134 and 1,040, respectively. The battery life of this portable's 3,750-mAh lithium ion pack, however, was 2:52 minutes,

the lowest of the units tested.

The 8000 also produced a 3D WinMark score that was startlingly low compared with those of the other units here. The reason for this is that the 8000's graphics accelerator doesn't support 3-D calls in hardware, so the system forced the test to run in software, which is significantly slower. But since the 8000 is built for an audience that demands powerful 2-D performance, the lack of 3-D prowess should not be an issue.

Given its speed and power, price and custom configurability, the Toshiba Tecra 8000 is notebook nirvana.

Toshiba Tecra 8000. Street price: \$4,400, with 14.1-inch display, 8GB hard disk, 24X CD-ROM drive. Toshiba America Information Systems Inc., Irvine, CA.; 800-867-4422, 714-583-3000; www.computers.toshiba.com; 406 at www.pcmag.com/infolink.



SLEEK LINES: You'll sacrifice neither power nor elegance with the Toshiba Tecra 8000.

face software. Although the software for both packages is bundled with the unit, you'll still need to install each manually to activate the hot-swapping and DMI functionality, respectively.

HP OmniBook 7150. Street price: \$5,000, with 14.1-inch display, 8.2GB hard disk, 2X DVD-ROM drive. Hewlett-Packard Co., Palo Alto, CA.; 800-752-0900, 970-635-1000; www.hp.com/omnibook; 405 at www.pcmag.com/infolink.

TOSHIBA TECRA 8000

If you're used to getting exactly what you want in a PC—and the idea of one motherboard and one software build (regardless of the hardware configuration) appeals to your TCO-busting, mindful-of-the-corporate-budget side—you owe it to yourself to check out the new Toshiba Tecra 8000. There may be only

Quite the contrary: The 8000 is a great desktop-replacement system that can be as high-powered as you want. And it's all rolled up inside a charcoal-gray case, which shows off Toshiba's expertise in engineering technically excellent mobile computers.

The most impressive aspect of the 8000 is not what it's gained, but what it has lost from the previous generation, the Tecra 780. To be precise, this notebook has shrunk: The 8000 is nearly half an inch thinner than the 780. Its travel weight, which includes the CD-ROM drive and the AC adapter, is just 7.4 pounds.

In that package, though, you get a brilliant 14.1-inch SVGA display, a 300-MHz mobile Pentium II processor, an integrated 56.6-Kbps modem, a 24X CD-ROM drive, and an 8GB hard disk, as well as composite video-out and 64MB of SDRAM. But the best part is the

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This image shows a blank, aged, cream-colored page, possibly an endpaper or flyleaf from an old book. The paper has a slightly textured appearance with some minor discoloration and faint, illegible markings along the top edge. The right side of the page is slightly shadowed, indicating it is part of a bound volume.

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First Looks

NETWORK INK JET PRINTERS

Easy on the Network

These ink jet printers lighten the load on networked PCs while affording users color at reasonable prices.

By Bruce Brown

New color ink jet printers from Epson America, Hewlett-Packard, and Lexmark International come ready to connect directly to networks without requiring or burdening host PCs. The Epson Stylus Color 850N (\$550 street), HP 2000CN (\$1,200 street), and Lexmark Optra Color 45n (\$1,300 street), each have direct network connections with built-in or attached print servers.

We tested the three printers on a 10-Mbps Ethernet small-office network with seven PCs running Windows 95, Windows 98 upgrade, and Windows 98 native operating systems using Microsoft peer-to-peer networking. Testing consisted of sending a variety of jobs to the printers, including a 43-page Microsoft Word mixed text and graphics sample and photographic images from Adobe Photoshop LE 4.0.

All three printers produce excellent text output that is practically indistinguishable from laser printing, but graphics and photographic-image print quality varied. Printing performance was time tested, though the numbers are valid only relative to each other, since other network installations will have different individual characteristics.

EPSON STYLUS COLOR 850N

The Epson Stylus Color 850N is targeted for small workgroups in business environments but not SOHO applications. Though it was the least expensive of the three tested printers, the Epson

unit still displayed good quality and printing speed competitive with the other printers.

We discovered, however, that the Epson spooler had a conflict with dial-up connections on the test peer-to-peer network on Windows 95 and 98 upgraded systems (but not on the Win-

dows 98 native system).

Arguably, many network printers would be installed on networks where users access the outside world via dial-up servers or other gateways. But if you are running Microsoft peer-to-peer networking with Windows 95 or upgraded Windows 98 systems that also make direct dial-up connections, the Epson may have conflicts. The company is aware of the problem and is working on a solution.

The dial-up conflict appeared after we successfully sent a print job to the 850N from a PC. When a subsequent dial-up connection on the same PC halted during the handshaking phase, a printer spooler error appeared and then went away, letting us carry on with the dial-up connection. Any later attempt to print from that PC failed until the PC was rebooted.

The 850N has an internal Ethernet print server with twisted-pair 10Base-T and thin coaxial

10Base2 connectors, plus standard parallel and Macintosh serial connections. Epson's Status Monitor 2 keeps track of the printer on the network and allows users to check ink levels, determine job status, and reroute print jobs to other printers on the network.

The dual-head, four-color CMYK Micro Piezo ink jet printer has a maximum resolution of 1,440 by 720 dpi (dots per inch), and it uses 128 nozzles in a 32 by 4 staggered arrangement. The 850N has a lifetime print volume of 75,000 pages, a 32K standard (and non-expandable) buffer, and a 100-sheet paper feed capacity.

The Epson Stylus Color 850N's print quality is excellent. Pages with mixed black text and color graphics, printed in normal 720-dpi resolution on plain paper, produced high-quality text with good edges. The graphics elements showed a little graininess in solid background printing. As is characteristic of the Epson ink printer line, the photographic image printed on glossy film was excellent, with fine consistent detail and true colors.

Printing speed was mixed compared with the other printers. The 43-page text and graphics test took 13.7 minutes to print, compared with 8 minutes for the HP and 17 minutes for the Lexmark. A full-page photographic image averaged 8.2 minutes on the Epson, versus 5.5 for the HP, and 5.9 on the Lexmark.

You don't have to wait for the entire print job to finish before regaining control of your PC.

After 3 seconds, even on the 43-page test, we regained limited performance access on the PC, with full performance delayed until the print job finished.

Color ink costs for the 850N are a little higher than the competing models', calculated at 9 cents per 15-percent color page (5 percent for each color) based on a 300-page rating for a \$26 (street) color ink cartridge. Black printing costs 3 cents a page (900 5-percent sheets from a \$26 cartridge), the same as the Lexmark and slightly lower than the HP.

The Epson Stylus Color 850N is a bargain that performs well as a moderate-usage network printer. The 850N produces good text and excellent photographic-quality images at good speeds for personal printers.

Epson Stylus Color 850N. Street price: \$550. Requires: 16MB RAM, 50MB hard disk space, Microsoft Windows 3.1, 95, 98, or NT 4.0 or higher. Epson America Inc., Torrance, CA; 800-463-7766, 310-782-0770; www.epson.com. 414 at www.pcmag.com/infolink.

HP 2000CN

The HP 2000CN is a fast printer that delivers both performance and quality to its targeted busi-

ness and professional small-workgroup markets.

With standard 400-sheet access from two paper trays, the 600-dpi printer uses 304 black



and 912 color nozzles with enhanced PCL 3 compatibility plus PhotoREt II for photo-quality printing to produce beautiful output in all modes.

In a departure from its earlier ink jet printers, the HP uses separate printheads (\$40 each, street) and ink cartridges (\$30 for each color and \$20 for black), one of each for cyan, yellow, magenta, and black. Consumable costs can therefore be kept down by replacing only the depleted ink color and by reusing the printhead.

The printheads are rated to last for 12,000 black pages and 24,000 color, and the ink cartridges are rated to last 1,750 pages for color and 550 pages for black. The rated per-page costs are 4 cents for a 5-percent black text page (a penny higher than the Epson and Lexmark printers) and 6 cents for 15-percent color pages (compared with 7 cents for Lexmark and 9 cents for Epson).

The printer has 2MB on-board memory and a 5,000-page-per-month duty cycle. A parallel interface—but no serial port—is included.

The HP Jet-Direct 300X print server, which snaps on to the back of the HP unit and includes automatic 10Base-T

and 100Base-T negotiation, supports all major networking protocols. The HP JetAdmin software, installed on any PC on the network that will address the printer, reports jobs and printer status.

According to the company, typical business users can install the 2000CN but might need technical support help with network interfacing, which was the case in our testing. The only problem we encountered was that one of our test PCs had two network cards installed, a con-

figuration not supported when configuring HP JetAdmin.

The HP 2000CN's print quality was the best of this capable field. Text was excellent with HP's pigment black inks. Graphics printed smoothly with no texturing in smooth areas. The photographic images on HP glossy photo paper stock were also very good. With the default settings, the photographic image colors printed a little darker than on the Epson or Lexmark units, but the image smoothness and sharpness of detail were excellent.

The HP was the fastest printer tested both in the mixed text and graphics sample (8 minutes average time) and the full-page photographic image (5.3 minutes average). Like the Epson, the HP returns some PC control to the user within seconds of starting a print job, but the pages are composed and spooled locally, using PC resources until the job is completed.

The HP 2000CN's speed and print quality make it a strong contender for business and professional workgroups. **HP 2000CN.** Street price: \$1,200. Requires: 8MB RAM (16MB for Windows NT), 15MB hard disk space, Microsoft Windows 3.1, 95, 98, or NT 4.0 or later. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; fax: 800-333-1917; www.hp.com. 415 at www.pcmag.com/infolink.

LEXMARK OPTRA COLOR 45N

The Lexmark Optra Color 45N isn't intended for SOHO or small-business users but for larger network users in a business enterprise. As a general-purpose, mixed-use network resource for printing color, this printer is a good choice.

The Lexmark was the slowest

of the three, but it was the only one that could handle wide media (up to 11 inches). And it was only unit that came with standard PCL (PCL 5 with color enhancements) and PostScript (Level 2) modes. The Lexmark auto-detects the incoming data

Vision printer management software can also be used to control and monitor the printer remotely.

Rated at 5,000 pages per month, this printer accepts media up to 11 inches wide in the front-mounted, 150-sheet

capacity paper tray. An additional 100 sheets of 8.5-inch-wide stock fit in a second tray.

Lexmark suggests that IT or MIS personnel knowledgeable in networking install the printer. Thorough documentation is included, but a missing step resulted in a call to

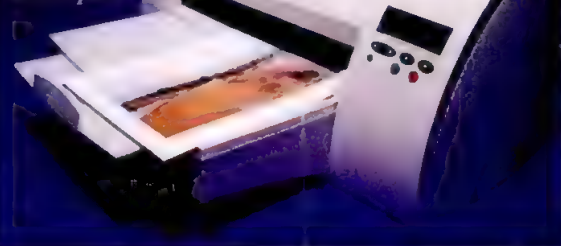
technical support. After this assistance, the printer installed easily and performed flawlessly on the network.

The Lexmark's black text output was superb, with clear, even edges. Graphics were acceptable, although we noticed a little roughness in what should have been a smooth gray background. Photographic image output was acceptable for internal use but not as clear as output from the Epson and HP printers, even when printed on Lexmark's glossy photo paper.

The Lexmark Optra Color 45N is the only printer we tested that has both PCL and PostScript modes standard. The 45N's control panel lets you set up and run the printer independently from a computer, and its on-board processing and relatively large memory frees up network PC resources faster than the models that use local PC page composition and spooling.

Lexmark Optra Color 45N. Street price: \$1,300. Requires: 2MB hard disk space, Microsoft Windows 3.1x, 95, 98, NT 4.0 or later, or IBM OS/2; Lexmark International Inc., Lexington, KY; 800-539-6275, 606-232-2000; www.lexmark.com. 416 at www.pcmag.com/infolink.

UN-PC: The Lexmark Optra Color 45N can be controlled entirely from its LCD panel.



stream and interprets print jobs with the proper mode.

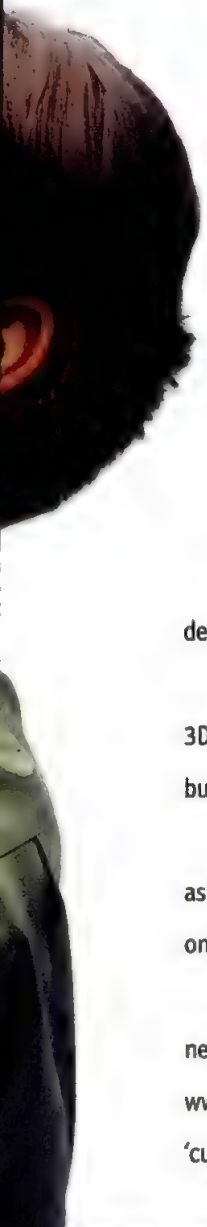
The Lexmark has a 33-MHz CPU with 24MB standard RAM (expandable to 72MB). Print times were relatively slow on the text and graphics test (averaging 17 minutes), but users get back full control of their PCs much sooner than with the Epson or HP printers, since page composition and spooling is done within the printer itself.

With a 600- by 600-dpi maximum true resolution and 1,200-dpi interpolated mode, the Lexmark printer is capable of high-quality output, particularly in black text. The CMYK printer uses two heads for four-color printing with the same black and color cartridges used by most of Lexmark's other color ink jet printers.

The internal MarkNet 10/100 Base-TX printer server with twisted-pair and coaxial-cable auto-detects incoming network speed and duplex mode and can run in a wide variety of network environments. Unlike the other printers, the Lexmark can be set up and managed entirely from its LCD control panel and navigation buttons; it even displays filenames of incoming print jobs. Lexmark's Mark-



MIND-BLOWING 128-BIT



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The RIVA TNT is the first 3D processor to provide hardware support for Microsoft's new DX6 API, as well as full OpenGL support for professional applications on the Windows platform of your choice. And it's available only from the best graphics card suppliers in the world such as Diamond, STB, Creative Labs and Elsa.

Whether you are running one of the many new graphics-rich business applications, or playing the hottest new games, the RIVA TNT will blow you away. But don't just take our word for it. Head to our website at www.nvidia.com and we'll link you to those who have experienced the RIVA TNT firsthand. Then brace yourself; 'cuz this baby will blow the 3D market sky high.

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First Looks

INTERNET

A New Look for America Online

AOL 4.0 offers improved Web navigation aids, more powerful e-mail, and greater security.

By Bruce Brown

After months of public preview versions and many beta candidates, America Online 4.0 has officially arrived. The new access program to the world's most popular online service has been updated with easier upgrades and system configuration, improved program and Internet navigation aids, broader content with increased personalization and customization options, greater security, and more powerful e-mail than earlier versions. AOL 4.0's changes and improvements—many of which are incremental—result in a richer, more convenient online experience.

GETTING AROUND

A colorful toolbar provides shortcuts to popular areas of the service and a single field for entering AOL keywords and Internet URLs. You can navigate from one online area to another easily

format, with updates throughout the day, and a search-and-explore feature. Each of the channels uses a consistent opening screen design, with channel listings on the left and department listings, features, and breaking news in the rest of the window. With new streaming media support, when you enter an online area with a slide show presentation, you can immediately see and hear the video and audio without having to wait to download files.

ENHANCED SECURITY AND E-MAIL

Security and privacy are huge issues with online access, and AOL 4.0 addresses these matters by providing a number of features. The integration of Microsoft's Internet Explorer 4.0 browser with its Secure

to improve its e-mail features. You can now enhance e-mail

messages with multiple text fonts, more color and text options than were available in earlier versions, and new spelling and grammar checks. A library of colorful letterheads, photos, and other art lets you enhance your messages for AOL 3.0 and 4.0 recipients. Users can now embed photos directly into e-mail messages. This process is made easier by an included Picture Gallery, which can be used to view and organize your digital photos.

Users who send files with e-mail now can attach multiple files to a single message in AOL 4.0 without having to compress them manually; AOL zips multiple files automatically. You can add clickable links to your e-mail or instant messages by dragging URLs from your Favorite Places. There are also special text options that can be used in chat rooms.

The Address Book automatically alphabetizes entries for individuals or groups and has the added ability to include notes and a photo for each entry. Group listings for e-mail make it easy to send a single message to all the people in a group simultaneously.

'NET TOOLS

The upgraded Personal Publisher 3.0, a free application for Web

page creation and publishing, makes designing and linking Web pages relatively easy. Personal Publisher provides an ample use of wizards and templates for choosing thematic styles to apply to your home page.

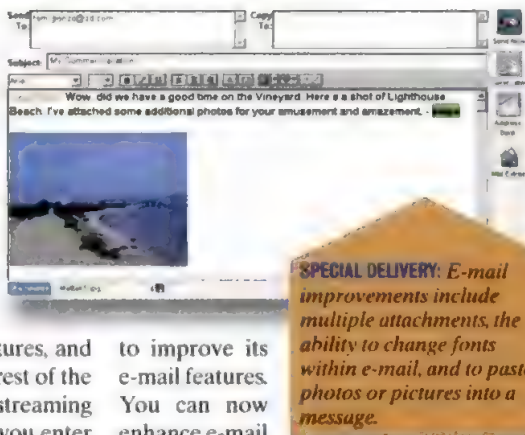
Two other tools enhance Internet functionality for AOL users. AOL Instant Messenger extends the AOL Buddy List to the entire Internet and immediately alerts users when listed family and friends

are online. People don't need to be AOL subscribers to register with AOL Instant Messenger, but they do need to sign up for their names to be detected.

AOL NetMail, available publicly to AOL subscribers (but still in a beta version), lets you check your AOL e-mail directly from the AOL.com Web page without having to dial in to AOL. This feature can be helpful when you're using a PC without AOL installed or even when you don't want to load the whole AOL program. To use AOL NetMail, an AOL account and either Internet Explorer or Netscape Navigator are required.

Current AOL users will appreciate the added content and features as well as the greater stability of AOL 4.0, which even in late beta versions was more stable than AOL 3.0. The experience is likely to be much less fraught with connection difficulties and much more rewarding.

America Online 4.0. Service plans: Unlimited Monthly, \$21.95; One Year Unlimited, \$239.40; Limited Plan: \$9.95 per month for 5 hours, \$2.95 each additional hour. Requires: 16MB RAM, 30MB hard disk space; 14.4-Kbps or faster modem. America Online Inc., Dulles, VA; 703-448-8700; www.aol.com. 410 at www.pcmag.com/infolink.



with the browser-style back and forward arrows. For quick backtracking, Favorite Places keeps a history of the last 25 areas you visited.

There are many ways to customize navigation in AOL 4.0—including the format, placement, and content of the toolbar and other user preferences in the My AOL section. For subject matter preferences, you can provide a list of interests and automatically receive suggestions of relevant AOL areas to investigate.

The 19 Information Channels in AOL 4.0 share a common

NAVIGATE: A colorful toolbar provides shortcuts to popular areas and a single field for entering AOL keywords and Internet URLs.

Sockets Layer (SSL) encryption strengthens the privacy and security of all information processed through AOL, including financial transactions.

In addition to your primary AOL password, you can set another password to protect your Personal Filing Cabinet. Other protective features include a Download Sentry screen (which will warn users who attempt to download files that could potentially contaminate their systems) and support for corporate firewall protocols.

AOL has also done a lot



Hey, Big Fish — outgrowing your pond?



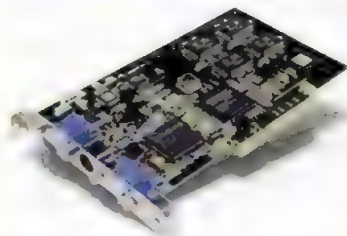
Multiple monitors give you more space.

Thinking about upgrading your monitor? Here's something they didn't teach in school — going from your current 17-inch to a pricey 21-inch is expensive, and it doesn't really give you that much extra room. This is what the smart fish do — get a second 17-inch monitor and use an Appian Graphics card to unite your two screens in a single display. Even figuring the cost of the card and the second monitor, you'll save yourself money. And you'll have a much bigger expanse for you to work and play. Appian Graphics is the leading supplier of



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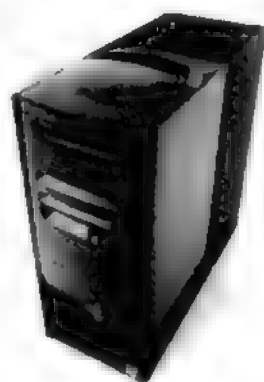
Big Ideas need room

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*Estimated reseller price to end users for Netfinity 3000 model 8476 0J and Netfinity 3500 model 8644 1CU. Certain features described below are available for an additional charge. Actual reseller prices may vary. For terms and conditions or copies of IBM's standard Limited Warranty call 1 800 772 2227 in the U.S. Limited Warranty includes International Warranty Service in those countries where this product is sold by IBM or IBM Business Partners (registration required). MHz denotes microprocessor internal clock speed only; other factors may also affect application performance. IBM product names are trademarks of International Business Machines Corporation. Microsoft, Windows and Windows NT are registered trademarks of Microsoft Corporation. Lotus, Domino and Domino Intranet Starter Pack are trademarks of Lotus Development Corporation. The Intel Inside logo and Pentium are registered trademarks of Intel Corporation. © 1998 IBM Corp. All rights reserved.

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First Looks

GRAPHICS SOFTWARE

SOHO Print Shop

Corel Print Office bundles all you need for simple business-oriented desktop publishing projects.

By Gayle Ehrenman

For small business owners who are desktop publishing novices or who simply want lots of hand-holding, help is on the way. Corel Print Office (\$99 list) delivers all the guidance beginners need—while still giving them the ability to produce professional-looking publications.

Print House (the desktop publishing application) takes a wizard-driven approach to creating projects. Users simply select the type of project they want to create, the style they want to use, and (in some cases) what form they want.

There are lots of sample projects to choose from. Business theme sets let you create a professional, coordinated look across a range of document types, including letterhead, brochures, invoices, and more.

Most of the styles are attractive and appropriate for business use. Unfortunately, you can't preview the style before you make your selection; your choice appears only when you move to the next screen.

The hand-holding doesn't stop once the document is created. A notebook appears on the screen to help customize the elements of your publication. The approach is intelligent: You select an object and it takes you to the appropriate customization options.

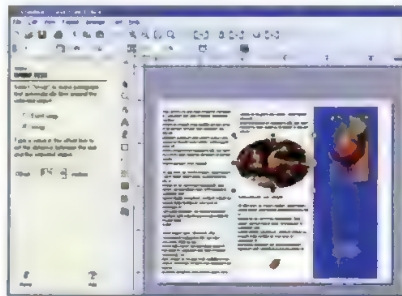
The notebook also offers pre-configured styles and a catalog for searching and accessing the wealth of clip art and stock photos included in the bundle. Print Office also includes a strong selection of vector drawing tools and the ability to publish documents straight to the Web.

Print Office is fine for creating short documents, but it's less useful for multipage publications. You can't view two-page

spreads, for example, as you can in Microsoft Publisher. Although Print Office makes connecting text frames easy so you can flow content, it doesn't indicate when there's more text than will fit in your frame.

It also doesn't provide a one-step solution to create text boxes with frames and tints.

The rest of the bundle is a mixed bag. Photo House is a good entry-level image editor



STYLIST: Print Office's notebook helps customize your publication.

that interacts well with Print Office. Merging addresses from Colleagues & Contacts into

Print Office documents is handy, but the information manager is much too database-oriented for the intended audience.

Corel Print Office is worth buying if you need a desktop publishing app, an image editor, and tons of clip media—all in a novice-friendly interface. Forget about the information manager and you won't be disappointed.

Corel Print Office. List price: \$99. Requires: 8MB RAM (16MB RAM for Windows NT), 65MB hard disk space, Microsoft Windows 95 or NT 4.0. Corel Corp., Ottawa; 800-772-6735, 613-728-3733; www.corel.com. 409 at www.pcmag.com/infolink.

PERIPHERALS

DVD-RAM Drives Arrive

Creative PC-DVD RAM, the first DVD-RAM kit on the market, may be the answer to all your drive needs.

By Alfred Poor

This sounds like a snake oil sales pitch: Get one drive that will satisfy your backup needs with more than 5GB capacity in each \$30 cartridge, read DVD-ROM and DVD movie disks, as well as all your different format CD disks. All

press the eject button and the tray that slides out is clearly something different. The slotted tray is designed to accept the DVD-RAM media cartridges. There's also a slot for DVD-ROM and CD-ROM disks.

The Matsushita-made drive is compatible with a wide range of DVD and CD formats. It can also be used to read and write PD (phase-change dual) media used in the Matsushita PD/CD drives. DVD-RAM uses a similar phase-change technology to make the disks read/write/erasable. This backward compatibility means this one drive can read a wide range of formats.

The drive works exactly like a hard disk. Windows 95 users can rely on the Universal Disk Format (UDF), which allows you to format the entire 2.6GB per side of the double-sided media as a single partition, even on Windows 95 systems running with FAT16. Windows 98 users can format the disks using FAT32, which results in about

4MB less capacity than UDF.

The drive is fast by optical disk standards. On our tests, we managed sustained sequential read rates of 1,350 KBps for DVD-RAM, 2,800 KBps for DVD-ROM, and 1,760 for CD-ROM. We also tested PD media and saw a sustained sequential read rate of 1,100 KBps.

The drive has fairly slow access times, however. The specifications call for average seek times of 120 ms for DVD-RAM media, and 85 ms for DVD-ROM and CD formats. When we copied five files totaling 20MB from the hard disk to the DVD-RAM drive, we got an average write rate of just 455 KBps, which was about one-third the observed sustained read rate.

The only major limitation is that the kit doesn't include MPEG-2 decoding. To watch DVD movies on your system, you'll need to add a card for this.

In spite of this slower write rate, DVD-RAM media and Creative Labs' kit look like winners and could unseat the other drive formats from their drive bays. **Creative PC-DVD RAM.** Direct price: \$500. Requires: 8MB RAM, 5MB hard disk space, Microsoft Windows 95. Creative Labs, Milpitas, CA; 800-998-1000, 408-428-6600; www.soundblaster.com. 408 at www.pcmag.com/infolink.



this is included, plus a PCI bus-mastering SCSI-2 adapter for \$500 (direct). Sound too good to be true? Nope, it sounds like the Creative PC-DVD RAM.

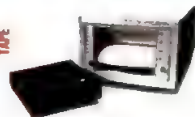
The kit consists of an internal drive and an Adaptec AVA-2902I adapter card. The drive looks like a typical CD-ROM drive, but



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First Looks

DIGITAL CAMERAS

An OS to Smile For

New cameras from Kodak advance digital imaging with FlashPoint Technology's operating system Digita.

By Bruce Brown

Kodak's two newest cameras, the Kodak DC220 and Kodak DC260 Zoom Cameras, are the first to market to include Digita, the new digital operating system from FlashPoint Technology. Digita's advances include a menu-driven design and support for scripts and applications. Digital is also upgradable and allows printing directly to a printer.

The DC220 (\$799 list), with a maximum 1,152- by 864-megapixel resolution and 2X optical zoom, is intended for avid amateur photographers. The higher-end DC260 (\$999 list), with a 1,536-by-1,024 maximum resolution and 3X optical zoom lens, adds focus range control and external flash synchronization to appeal to professionals.

Both cameras have Motorola PowerPC 800 processors, 2-inch color LCDs for composing and reviewing images, and audio recorders. The Kodak units are among the first cameras to market with USB connections for fast image and data transmission (serial or IrDA transmissions are also supported).

FAR-REACHING BENEFITS

If Digita evolves into the standard OS for digital cameras and other imaging products (such as printers and televisions), consumers will benefit from increased functionality and ease of use, not to mention lower prices. The expected increased sales volume could benefit the entire digital imaging industry.

Digita reduces dependence on a PC for sharing digital images. With only a camera and a printer, you can capture, view, add voice and text annotations, store, catalog, and print. You can also use the included video

cable to display images on NTSC or PAL televisions or video monitors. Uploading images to the PC becomes an advanced editing, transmission, and image storage option.

The most obvious advantage of the Digita OS is each camera's easy-to-follow icon- and menu-driven interface. First-time digital camera users can easily scroll through capture and review menus to select basic and advanced settings.

Digita's open design lets users develop scripts to automate common imaging tasks and turn them into menu options. This feature can be used to automate standard images needed in specific industries. A real estate agent, for example, could take pictures of ten different homes, all in the same format. And the life of any Digita device can be extended by uploading OS enhancements.

CAMERA CAPABILITIES

The DC220 and DC260 each have a similar look, feel, and operation. Using the zoom lens, status display, built-in flash, LCD, and viewfinder is intuitive. Each camera comes with four double-A alkaline batteries, an AC power adapter, a removable 8MB CompactFlash memory card, an audio/video cable for the camera/TV connection, a serial cable, and a USB cable.

When you power-on either camera, there's a delay of about 10 seconds before you can shoot, which can cause you to miss a shot. But because power consumption is low during standby mode, you don't have to turn the

camera off after every capture.

Once the camera is powered up, you can take two shots rapidly with no delay before the camera starts processing the first image. There are three image modes: still, time-lapse (a series of pictures with time delays), and burst (a series of pictures taken in quick succession). There's also a 10-second self-timer.

Battery life varies with use of the color LCD, but in testing, a

has an ISO equivalency of 140, shutter speed range of 1/2 to 1/360 second, and aperture range of f/4.0 to f/16.0. The only advantage of the DC220 over its more powerful brand mate is an 8-inch near-focus limit (the DC260 has a limit of 12 inches).

In addition to higher resolution and greater zoom capability, the DC260 has three other features not included in the DC220: flash synch (which lets you connect an external flash) and extended focus range.

With the third feature, photo album, you can arrange pictures into albums right in the camera, which is useful for organizing images before uploading them to your PC.

IMAGE QUALITY

The reason to buy a digital camera is to capture images, and these two new Kodaks definitely deliver. The DC220 produces fine-resolution images comparable to those of other megapixel cameras.

The DC260's 1.6-megapixel format lets you store only 14 images on the standard 8MB memory card. But the card holds so much information that you can shoot wide to be sure you capture a full image, and when you crop it, you'll still have sufficient detail for fine images to display or print. Both cameras produce gorgeous, true-color images.

The DC220 and DC260 represent significant advances in hardware from Kodak. And the new Digita OS promises greater ease of use for the beginner and greater control and programmability for advanced users.

Kodak DC220 Zoom Camera. List price: \$799. **Kodak DC260 Zoom Camera.** List price: \$999. Requires: 16MB RAM, 50MB hard disk space, Microsoft Windows 95 or NT 4.0. Eastman Kodak Co., Rochester, NY; 800-235-6325, 716-724-4000; www.kodak.com. 411 at www.pcmag.com/infolink.



Zoom in: Print your digital images right from the Kodak DC260 (front) and DC220 zoom cameras.

set of alkaline batteries lasted for about 60 image captures with moderate use of the LCD. Kodak's accessory kit (\$249 list) includes four double-A nickel hydride cells with a recharger, a 16MB CF card with a PC Card adapter, and a camera bag.

Digital magnification boosts the DC220's 2X optical zoom lens to 4X and the DC260's 3X lens to 6X. The DC260, with shutter speeds from 1/4 to 1/400 second, ISO equivalency of 100, and aperture range of f/3.0 to f/22.0, is rated to produce sharp printed images of up to 8 by 10 inches.

The DC220 is rated for maximum 5- by 7-inch images and

First Looks

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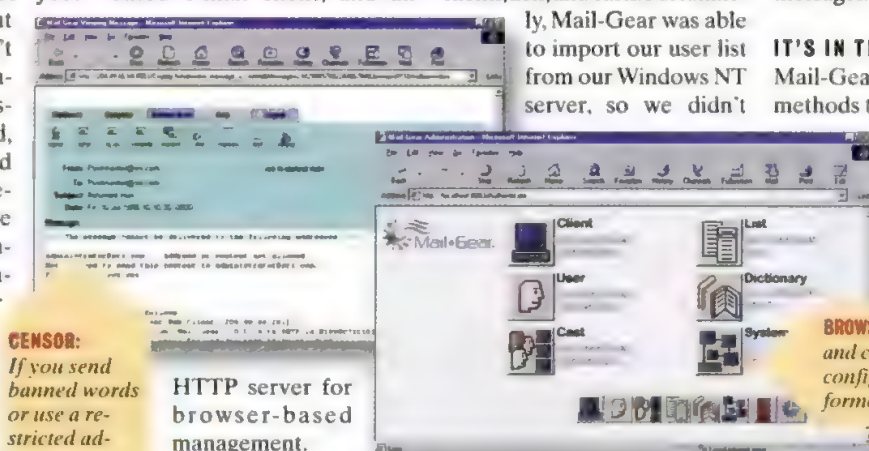
Mail-Gear is the first product to give network administrators total control over their users' e-mail.

By Steve Rigney

There are lots of products that let you control how, when, and where your users surf the Web, but these products don't protect them from unwanted e-mail messages. With this in mind, URLabs developed Mail-Gear 1.0 to prevent pornography, hate mail, and other offensive material from entering or leaving your e-mail server. Mail-Gear is the first product that allows you to control what messages your users can send or receive, with whom they can exchange messages, and schedule when they can access the e-mail system.

Because Mail-Gear is based on open standards, it works with both local intranets and networks connected directly to

the Internet. The Mail-Gear package is composed of an Internet mail server, a Web-based e-mail client, and an



CENSOR:

If you send banned words or use a restricted address, Mail-Gear returns the message.

HTTP server for browser-based management.

The bundled mail server adheres to the POP3 and SMTP standards and works with most e-mail clients. On our tests we used Netscape, Internet Explorer, and Eudora e-mail client utilities without any problems.

The bundled Mail-Gear

Web client lets you send and receive e-mail using almost any Web browser running on any platform. The only item missing is an automatic update and notification feature (you must reload or refresh the page to receive new messages).

After the mail server is configured, you must create users, clients, lists, and casts. Fortunately,

Mail-Gear was able to import our user list from our Windows NT server, so we didn't

created a cast that wasn't allowed to send e-mail after a specified time. To increase our control, we created a list of e-mail addresses that were blocked for either all or some of the users and clients. The dictionary feature allowed us to add words we didn't want to appear in any incoming or outgoing messages.

IT'S IN THE MAIL

Mail-Gear provides several methods to enforce your rules.

One method is to block or return messages to any sender who breaks any of the established content rules.

BROWSE: All e-mail server and content management configurations are performed with a Web browser.

You can also configure the utility to

forward the message to the administrator and let him or her decide whether to return it, delete it, or let it pass through.

Mail-Gear also includes reports to show which users broke the content rules. If a user repeatedly breaks the rules, you can use the AutoLock feature to disable his or her mail account.

Though all of this may sound drastic, the system works. And where schools and kids are involved, that's what matters. In an office environment, Mail-Gear can be used to yield greater control over employees' e-mail habits, so let this be a reminder that your office e-mail is not private.

Mail-Gear 1.0. List price: 100 users, \$2,495. Requires: 64MB RAM and 15MB hard disk space, Microsoft Windows NT Server 4.0 or Sun Solaris 2.5 or later. Unified Research Laboratories, Hampton, VA; 800-989-5227, 757-865-0810; www.urlabs.com. 413 at www.pcmag.com/infolink.

Filtering in the Right Context

The folks at URLabs were pretty clever when they developed a product to control e-mail traffic and content, but that's not the only solution they offer. The URLabs flagship product, I-Gear (\$2,495 for a 50-user license), helps you control users' access to the Web. I-Gear lets you use a standard browser to allow, deny, schedule, and even keep a record of users' access to certain Web sites. There are several other URL filters or Web content managers on the market, but I-Gear's Dynamic Document Review (DDR) feature makes it one of the most versatile.

I-Gear currently includes a list of approximately 300,000 URLs that cover over 10 million Web pages. The list, which is updated and sent to customers once a week, is broken down into categories—

such as sex, hate, crime, and sports. You can also add your own sites to the list.

We found all of the features of the product easy to use. The most powerful feature is the DDR scanning technology. DDR scans each Web page on the fly to determine if it contains a blocked word or phrase and goes one step further to determine its context. For example, DDR can deny access to pages that combine the words *live sex* but permit access to pages that contain the phrase *sex education*. Most URL filters will simply see the word *sex* and block all access to that site.

I-Gear. List price: 50 users, \$2,495. Unified Research Laboratories, Hampton, VA; 800-989-5227, 757-865-0810; www.urlabs.com. 413 at www.pcmag.com/infolink.—SR

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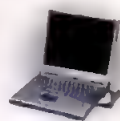
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Second Looks

QUAKE II

Addicted to Death

By Michael E. Ryan

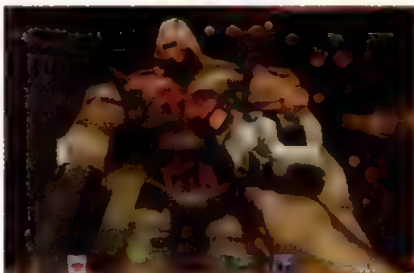
When we first reviewed id Software and Activision's Quake II back in March, we were blown away by the game's intense single-player action and incredible 3-D graphics engine. The only flaw was the game's unstable multiplayer support. To address this, id has since released half a dozen patches to resolve the multiplayer issues and has otherwise tightened up what was already an excellent game. The result? Quake II is now clearly the best all-around first-person action game on the market—and one of the most popular computer games ever.

The reasons behind Quake II's immense popularity are simple enough. Some people play it to enjoy the fast-paced action of a single-player game. Others get a kick out of the intense 3-D graphics. As with most games, however, these thrills quickly begin to wear thin.

So what keeps game players coming back to Quake II, even as the game approaches its first

birthday? Based on our own Quake II experiences and the overwhelming majority of feedback we received online, multiplayer death matches are the game's single most enjoyable and addictive feature. As many readers have stated, the thrill of playing against live competition is about as exciting a gaming experience as you can get.

We wholeheartedly agree, and there's no finer feeling than peppering your friends with the hyper-blaster at close quarters. Vi-



olent? Yes, but harmless—and even a bit therapeutic after a stressful day at the office. Also, unlike death matches in the original version, Quake II contests are more balanced (in other words, the rocket launcher and the quad damage no longer let you dominate). This makes the game more approachable, without sacrificing any of the action hard-

core fans have come to expect.

One of the other reasons Quake II has remained so popular is the game's customizability. Using a wealth of shareware-editing utilities, would-be developers can create new weapons, new maps, new game graphics, and even completely new games to run on top of the Quake II engine. There are hundreds of new levels and mods for the game floating around the Internet—with more appearing every day.

With crowds of unpredictable live opponents playing Quake II over the Internet and scores of part-time game developers coding new extensions, we doubt that Quake II will ever become truly old and boring.

DIGITAL CAMERAS

Not Just Toys

By Thom O'Connor

In my 30 years of professional photography experience, and now as *PC Magazine's* staff photographer, I've been playing with digital cameras for more than 15 years. I chose the word "playing" because, until recently, digital cameras were mostly just interesting toys.

We've tested a long list of digital and video capture devices. Some looked like real cameras, some like reject science fiction props. None really came close to delivering film-quality images (shorthand for something as good in color fidelity, contrast range, and sharpness as a 35-mm Kodachrome slide). This is a high mark to aim for—a mark digital cameras never came close to hitting. Until now.

Now we have high-end cameras that produce images that meet or surpass that Kodachrome benchmark standard. Sure, they're big-bucks cameras, but the technology driving them is flowing down to all those sub-\$1,000 digitals. This year's cameras are better than last year's, and next year's will be better still.

Okay, they're still not as good as a top-rung 35-mm camera loaded with high-quality film. But rather than agonize over image quality, ask yourself what you do with your pictures.

At *PC Magazine*, we use the Kodak Professional DCS 460 dig-

ital camera. The 460 cranks out high-quality digital images (at 3,060 by 2,036 pixels) for printed reproduction at enlargement sizes up to about 4 by 6 inches. No film, no processing, no waiting. And when we need a highly detailed image to run across a full page, we haul out the old film

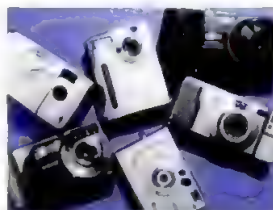
cameras. Different cameras, different uses.

The same principle applies to affordable digital cameras. Use them for instant

shots of the family, the dog, the vacation trip—and you'll get the same use out of them as you would from a simple 35-mm camera.

The difference is that you can instantly off-load the images to a PC. Or you can attach the images to e-mail or plug them into Web pages. Or even port the images to a photo-quality printer to make album-worthy hard copies.

If you're seriously into 11-by-14 color prints of sweeping landscapes, 8-by-10 glamour portraits, or razor-sharp still-life shots, affordable digitals won't make you happy. At least not yet.



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Tell us what you think...How do you like the new products you're using? Second Looks is your forum for feedback. Join us online to tell us about your experiences. We discuss a different new product every week and summarize your comments here. Below, you'll see why people can't stop playing Quake II.

Quake II is one of those games that really can't be appreciated until you play against a real live person. With 16 people on one level, "blood bath" has a whole new meaning. There is nothing better than killing 16 of your closest friends.

—Falyaz Ahmed

The thing that keeps me coming back to Quake and Quake II, while most other games more than a few months old sit in their boxes on my bookshelf, is the ability to customize almost every facet of the game with just a bit of programming experience. To tell the truth, I haven't played original Quake without a patch in over 6 months. My personal favorites have to be Strike Team for Quake, and (at least from the alpha releases) SWTC for Quake II.

—Blindside



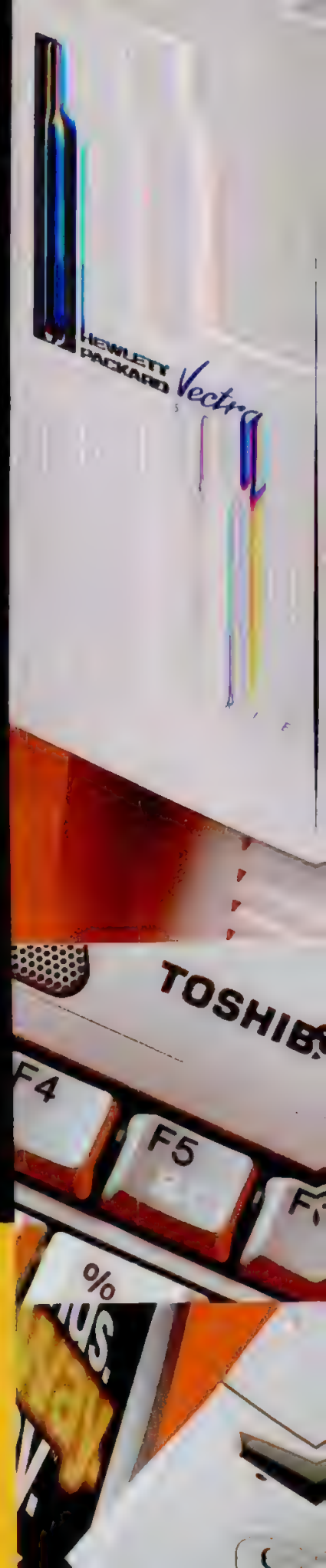
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The Untrained Executive

Today I saw the most amazing thing. A guy my age (yes, that old!) with a very new-looking Toshiba Tecra 740, diagonally across the aisle from me on a United flight. Laptop computers on airplanes have become such a commonplace that they're no more

worthy of notice than the in-flight magazines, but this fellow caught my attention because I kept hearing the unmistakable sound of a Windows 98 boot sequence.

I surreptitiously—dare I admit it?—watched him work for a while. He had a senior-executive aura about him; definitely not one of the downtrodden wage slaves. He was in Microsoft Word, writing a complaint letter about the flight we were on, about how two women had gotten upgraded to first class and he hadn't, how some defect in the armrest of the seat in front of him was threatening his knee and the flight attendant ignored his request for a piece of tape to place over it, and who knows what else. The letter wasn't the amazing thing; I was astounded by his utter lack of competence with the machine in his lap and its installed software.

He obviously used it a lot, because his My Documents folder was filled with documents with titles of the "This is the first sentence of my letter.doc" variety. His typing wasn't half bad, and he used at least some of Word's features, but every time he did an intermediate save on his file, he hit Ctrl-Alt-Del or found some other way to bring up the Close Program dialog box. Once he did this, he would inevitably (as far as I could tell) hit the Shut Down button and reboot the machine. He would restart Word by clicking on his file in the My Documents view, and by some luck, the saved file or a recovered file would be there.

During one of the many boot sequences, he managed to click on some Norton Utilities wizard that launched a lengthy sequence of processes that displayed file menus and a seemingly interminable series of progress bars. He sat patiently through the entire, 10-minute performance, then launched his letter again and resumed his litany of complaints.

Maybe it was a good way for him to fill his flight time, but I thought about him and all the other clueless users he was a proxy for. This guy didn't even know enough to be angry at all the goofy things that were going by on his

screen, but just accepted them placidly. I had half a mind to write a letter on his behalf to the IT manager in his organization, to find out how this road warrior could be so poorly equipped for battle. If this guy had spent as much time in training as he did waiting for his machine to reboot, he could have written half a dozen complaint letters.

Still, executive egos can be frail things, and the idea of taking a competency exam before being turned loose with one's laptop wouldn't fly in many organizations. That doesn't mean it's a bad idea, however, just a hard one to implement.

Our own CIO, Steve Gladyszewski, sums up the problem of executive computer illiteracy succinctly: "I've given up." In 20 years of IT experience, he says, he has yet to find the magic incentive that would get execs to spend a couple of hours in training that would pay them (and the company) back handsomely in the coming weeks and months. "In our own company," he admits, "we have senior managers who don't use their machines effectively. We could show them ways to get their time back a hundred-fold." He tells of seeing managers "task switch" by closing one program before starting another, and countless other horror stories.

"When they ask, we do everything we can to help them," he says. "But a tiny amount of training would make their lives and our help desk lives im-

measurably easier." Gladyszewski says the problem is just as prevalent in high-tech firms like ours as in low-tech firms.

As we landed, I tried to think of a way to ask my clueless cabinmate, in effect, why his computer rebooted so often (not suggesting that he was at fault, of course), but I quickly lost him in the landing rush as he bolted for the door.

Chances are excellent that he won't be reading this column, and he wouldn't have much to say about it anyway. But if you've got a solution to the executive-training conundrum, drop me a line at bill_machrone@zd.com. 



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This past summer, the manic interest in Internet portals has led to a run up in the stock prices of various companies involved in the portal game. It's about time users crushed this stupidity and put their own personal portals online, which is what a *home page* was

supposed to be in the first place.

The portal mania began when someone made a calculation based on the possibility that people using the Web would remain too stupid to learn how to change their browsers' home pages. They would forever see the Netscape home page and be subjected to endless advertising. Soon companies evolved that would replace Netscape's home page with portal sites. But the logic of this gives initial portal prerogative not to Netscape or even Microsoft but to vendors like Compaq, Dell, and Gateway. When they ship machines with everything preconfigured, the vendors can preassign their companies' portals as defaults for the hapless user.

Meanwhile, lots of companies want to be your portal. Let's look at some current faves: Excite, Lycos, and Yahoo! These companies became portals only because they discovered that their primary reason to be—searching the Net—was futile. So now this. Some strategy.

The fact is, the best portal is the one you develop. Go look at my example at www.dvorak.org/home.htm. This is my personal portal, or home base, or hub, or whatever you want to call it. I've isolated the best search engines, the best metasites, the best of the best, and made a simple list that I can refer to quickly. I say quickly because, though a copy is kept on the Web, the page is actually on my C: drive for instant loading. This home page is just a text list, so load time is minimized, too. And when I'm on the road, I can call this page up from the Web and don't have to wait for it to download a lot of graphics.

The speed factor, I think, is what will drive people to personal portals. When I click on Internet Explorer, I usually have something in mind: I'm going someplace; I'm looking for something. I want my list on the screen quickly. Nothing is more annoying than clicking on the browser icon, then waiting an eternity for the thing to open because it's loading something off the Web that I don't want to see.

When I mention my personal portal to boosters of commercial portals, they always use the same lame excuse I've

heard for 20 years: "Users are idiots who don't want to be bothered with any of this." Actually, few users are idiots; most simply don't know what to do. And you can be sure that none of the millions who read *PC Magazine* and influence the others are idiots.



PORTAL MANIA
Too many sites
are trying to lock
users down and
make them
prisoners of
their pages.

It's actually easier to do your own page than to "customize" one of the portal pages. Most of the so-called customization just leads you to suggestions from the portal companies, which are bought and paid for. Worse, they're boring. Never once will the portals suggest one of the great metasites or the marvelous Tucows download site. Everything is designed to show you advertisements. Don't get me wrong: I'm all for making money on the Web, but when I'm in a hurry I don't want to wade through banners and promotions and free offers.

For the long term, all the portal people can hope for is an America Online-type audience—not the sharp users many advertisers want to attract. Furthermore, making a site a possible portal is not that difficult. Ziff-Davis is working on this, as is every newspaper in the country. They argue that people want the local news when they first turn on their PCs. Yahoo! and others can move into those markets and do joint ventures with the pitch, "We know portals!" But in fact, portals are trivial.

Most of the metasites I've included on my Home.htm page are perfect portals themselves. I find MEL (the Michigan Electronic Library), for example, more valuable than Yahoo! for basic research. It's a nonsense site full of fantastic links. Then there's the obscure Usernomics, a site of metasites, kind of a meta-metasite. Once you discover this site, you could be lost for days.

The problem with the current crop of commercial portals is that they never lead me to anything that remotely competes with their products. That's the key word: *product*. I don't go on the Web to get locked into a product or site. I don't want to be stuck in a closed loop. No wonder people say they can't find anything on the Web. Too many sites are trying to lock users down and make them prisoners of their pages. Break your chains and make your own portal!

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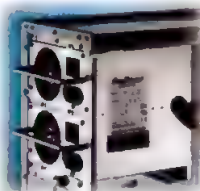
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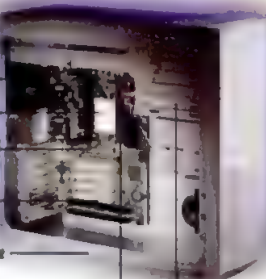
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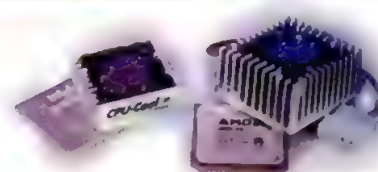
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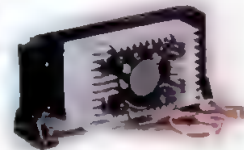
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Inside Track

While the Boss Is Away Dept.: Just a year ago you might have thought the Merced (IA-64) would be taking over the world about now. The delay was announced, and we have to wait. Not wanting to miss a beat, Cyrix will aggressively go after the **soft spot** between the Pentium II and IA-64 with a chip code-named Jalapeno, which has a 600-MHz performance rating. According to reports, Cyrix wants to take advantage of some new CMOS processes it picked up from National Semiconductor. Here we go again. To complicate things more, *EE Times* reported that **Cyrix may jump** from the AMD 3DNow! extensions to an implementation of the Intel KNI (Katmai New Instructions). Watch this battle take center stage in the next 18 months. Also look for the sudden emergence of discussion over—get this—a Level-3 cache for these **hyperhertz** chips.

System on a Chip Dept.: The biggest buzz in the semiconductor business is about putting **all the components** of a computer on a single chip so it can be incorporated into everything from sub-\$500 desktops to fancy set-top boxes to cars. This concept is nothing new, and it's surfaced before with wafer-scale integration, among other **failed schemes**. Engineers want to do something new with chips after they're designed, and specialized chips can't handle the chore. Then there's the "problem" of circuitry improvement. This is why the general-purpose CPU surrounded by support and special-purpose silicon has been the **preferred** architecture. Still, this latest attempt at putting everything on a chip seems to be gaining momentum.

Sanyo has now entered the game by licensing custom semiconductor technologies from IBM, including the PowerPC and important **copper interconnect** technologies. Sanyo will use these technologies to bolster its position in the consumer market with an emphasis on digital TV, phones, DVD, and the rest of the line. Initial reports say that Sanyo will also push into the **pocket computing** arena, but I suspect we'll see a sub-\$500 desktop from Sanyo, too.

Intel's End-Around Strategy Dept.: Because everyone is getting into the semiconductor game, targeting cheap computers, TVs, and PDAs, Intel has been having **strategy meetings** as never before. It now seems as if the company that manufactures the Alpha and ARM chips will take an aggressive marketing position with the fabu-

*I have at least
one report of
foreign customs officials
looking for
illegal pornographic
images in laptops.
I assume they confiscate
the laptop and perhaps
fine or jail you.*

I've mentioned before that Intel has always been a serious NIH (not invented here) stickler and could never bring itself to market a design it didn't develop in-house. That may be changing as Intel has **too many battles to fight** on too many fronts. Now it looks as if the company may use its marketing muscle to push the StrongARM into everything it can. The 1500 is a 3.3-million-transistor, 2-volt, 32-bit chip running at 300 MHz that consumes only 2.5 watts. Its DSP-like characteristics are similar to those of the PowerPC. This little chip can **decode MPEG-2 and run a software modem** at the same time, for example. In many ways the chip will compete directly with the aging Intel i960, the remaining sore point at the company.

Incompatibilities Rule! Dept.:

By showing up in pocket computers, the StrongARM 1500 will add yet **another layer of incompatibilities** to the next generation of hand-held devices. The various Windows CE machines are already mostly incompatible with one another, because they use a variety of CPUs. This gives the PalmPilot the clear edge for the short term. I also believe that developers are trusting Microsoft less and less because of its **public reputation** as a **take-no-prisoners** kind of company. Why develop for a Win CE machine if you suspect that Microsoft will take over your niche if it's showing profits? This subtle phenomenon is the **biggest threat** to Microsoft's future. Ironically, Microsoft will have brought it on itself. I suspect we'll see developers slowly moving away from Microsoft's platforms out of a simple need for self-preservation. Once this trend reaches critical mass, things will change. It **bodes well** for Apple, Linux, and Palm, among others.

The newest incompatible device is not the latest Win CE machine: It's Sony's new flash memory for digital cameras. Looking like a stick of chewing gum and weighing 4 grams, the **Sony Memory Stick** will now compete with the Compact Flash (Kodak) and SmartMedia (Olympus and the rest) cards. Initially the cards will hold 4MB and 8MB and cost \$23 and \$31, respectively. They're expected to be somehow used in—among other things—cameras, phones, and car navigation systems. These developments are going to **continue to muddy the waters** of standardization for the next few years.

Aside Dept.: The nicest plasma display I've seen for quite some time is the new 50-inch, 16:9-ratio flat screen from Pioneer. \$20,000, when you can get one.

Snippet II: I have at least one report of foreign cus-

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From PDAs to USB Never-Never Land

Last time I explained why I think that despite the PalmPilot's enormous and well-deserved success, the newer Windows CE 2.0 hand-held PCs (HPCs) and their successors are going to be serious, maybe dominant players in the personal digital assistant

market. And I promised to pass along some thoughts on what else we really *need* in PDAs. I've been surveying friends for some time on the functionality they'd like to see in PDAs, so the credit (or blame) for what follows is theirs, too.

In declining order of importance, here's what I want in a PDA, beyond contact lists, note taking, and other relatively low-level functions available today on the Palm platform and in Win CE 2.0 boxes.

At the top of my list is a smart cell phone. Naturally, it should be well integrated with the other programs and data on the machine so that I can, for example, tap a listing in the contacts file to auto-dial a number. Better still, the cell phone should have client-side features that link to external metaphone services such as Wildfire, for truly up-to-date telecom.

Next is a GPS receiver with detailed U.S. street maps stored in ROM. A single antenna must serve both cellular and GPS requirements. Cross-linking the GPS input with other resources on the PDA is essential; for example, you could click on a contact listing and get a GPS-driven display that shows that address. And since the device always knows where I am, it shares that information with its other apps.

Third, one-touch—make that one-tap—connectivity to e-mail, through a national wireless Internet/ISP connection. I send a lot of very short e-mails, often just a couple of words: "No, thanks," "Do it," "Call me," and so on. I don't want to write long epistles on a PDA—*any* PDA—no matter how good handwriting recognition becomes, but I do want to be able to scan the first couple of lines of incoming messages (which stay on my mail server) and zip back quick answers when appropriate.

Fourth, a usable if limited-vocabulary form of voice recognition, so I can seek answers ("Charles Walker's phone number"), make brief entries ("Appointment with Ellie Sanders this Thursday at 4:00 P.M., her office"), or take actions ("Call Martin Short") by speaking into the PDA's microphone. The system has to be smart enough not only to recognize my words but also to understand their context, so it can act on them.

Fifth, I want high-compression voice recording, with reliable speech-to-text conversion of my audio notes when I need it. Win CE 2.0 machines already have simple voice recording. New PDAs need to take that to the next level, by making the recorded messages available in text form—so

that, for example, I can input a longer-than-two-or-three-word e-mail text message by voice.

Sixth, I need an integrated tone dialer. I should be able to double-tap a contact, then hold the PDA up to a phone handset as the PDA beeps out the number, effectively auto-dialing. (PDA users who make a lot of calls from airport pay phones will immediately understand.)

Finally, I want a digital pager in my PDA, with all the features we've grown used to in up-to-date paging.

Those are my Big Seven PDA Improvements. They have to be delivered in a unit no larger and not much heavier than the Palm III or the Win CE 2.0 Cassiopeia machine I've come to rely on. And I want them all internal: designed, built, and supported by one hardware company and one software company. We'll have all the features eventually—but not soon.

The problems lie not in the vision of those who design these boxes and their operating systems and apps but in some of the physical realities of PDA design. We need a big leap forward—or likelier, a series of related smaller leaps—in battery life and reduced power consumption. Both the circuit-design and battery-

design folks are working on this and have made improvements, but we're not yet anywhere near where we need to be on either front.

We also need more powerful CPUs in these little boxes. I don't care whether they're the StrongARM chips newly (and tentatively and confusingly) adopted by Mother Intel or proprietary chips from other sources. But we need big improvements in processing capacity and speed in microprocessors for little computers, and we need them quickly. Even with better batteries and reduced power consumption, these enhanced PDAs won't work without more horsepower.

What's the big risk? That in listening to me and another



NEXT-GEN PDAs
The problems lie not in the vision but rather in some of the physical realities of PDA design.

Find out who Dvorak insulted this week.

Opinions

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JIM SEYMOUR

few million devoted PDA users, hardware and software designers so bulk up hand-held computers that they take away PDAs' greatest appeal as small, light, easy-to-use things you can stick in your pocket. Much of the success of the PalmPilots has been based on a simple formula: Small size and weight plus a few really useful functions equals market success. Avoiding featuritis has been key to Palm's success and to the success of the Win CE 2.0 devices. And I worry about the reliability of more complex devices.

But there comes a time when you have to increase both the perceived and real advantages of these gizmos, or buyers will think twice about spending \$300 to \$500 on a cute, pocketable, but not useful enough machine.

The Great USB Hunt. I've been looking for new USB products to recommend. I'm a fan of the USB (Universal Serial Bus) and look forward to exploiting its ability to daisy-chain lots of fast devices to my PC. Unfortunately, though Microsoft now has native USB support in Windows 98 (and has had downloadable add-on USB support for Windows 95 for some time), few truly useful USB devices have appeared.

The best one I've found yet is the little QuickCam VC. I've used Connectix "golf ball" video cameras for years for low-level videoconferencing—almost exclusively two-way "video calls" over the Internet back to my family—while I'm traveling.

Now the little black Connectix QuickCam VC in its USB version is a superior product (for the price, remember: \$99) that really uses the USB link. A parallel-port QuickCam is available too, and works okay, but if you have a USB port or two on your PC, you want the USB version. Connectix just sold the QuickCam line to Logitech; Logitech's excellent products and support make that good news.

More interesting still are two new products from Inside Out Networks. IO has an interesting, real-world twist on the USB. The IO Hubport/7 (\$199 list) is a nice if conventional seven-port USB expander. But the \$399 IO Hubport/4 recognizes that there still aren't many USB devices around and so plugs into your PC's USB port but delivers four standard 9-pin serial ports for conventional RS232C serial devices.

Not every serial device and its associated software will work with COM5, COM6, COM7, and COM8, but most will. And IO gets you out of a not-enough-serial-ports jam without making you go under the hood, wrestle with IRQs, and so on. Excellent products, highly recommended, with fair prices. 

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Digital Photography Comes of Age

Have you dabbled in digital photography in the past and found the technology wanting? If so, think about giving it a shot again. To be sure, digital photography technology remains a work in progress. But it's good enough to work well for about half the things

you might use a camera for. Does that sound like a faint endorsement? I'd call it a realistic endorsement. The glass is finally half full.

For me, the "Eureka!" moment for digital photography came when I electronically stitched together a panorama of digital pictures of the family cabin in the woods and the brook that runs alongside it. Something I'd been trying to do with limited success for years using an X-Acto knife, traditional photographic prints, and art tape fell into place in less than an hour with a digital camera. You could take panoramic shots with a specialized film camera that takes full 360-degree panoramas and costs \$10,000 or rents for several hundred dollars a day. But you never would.

Think of digital photography and traditional film-and-chemicals photography as parallel technologies rather than as one-lives, the-other-dies competing technologies—at least for the next decade. Digital does some things better and some things worse (a lot worse).

What you're getting this year is more quality and more convenience. Currently you can buy megapixel digital cameras for around \$500. *Megapixel* means at least 1,000 pixels on the long side of the image: 1,280-by-960 or 1,152-by-864. Vendors say that's good enough for 5-by-7 prints; I'd say it's good enough for 4-by-6 prints. We're about to see 2-megapixel cameras, which for sure will make great 5-by-7s and possibly even 8-by-10s.

For all that, you need more storage, and fortunately memory is getting a lot cheaper. Compact flash card memory has doubled again and is up to 64MB. Smart memory cards (those are the thinner, more flexible cards) typically contain one-third the memory of compact flash. 64MB equals one to two rolls of 35-mm film, depending on whether you shoot at the highest resolution.

By year's end, most printer vendors will have direct-print options: You drop in the memory cartridge and print every picture, a proof sheet, or selected pictures only. The printing part is convenient; selecting the pictures is a real hassle with a lot of cameras, because you have to fiddle

with Function, Select, Back, and Forward buttons. As more cameras get USB ports, you could (in theory, if it all works right) pipe pictures from camera to PC and printer and use your keyboard to control what gets printed. As a minimum you'd get faster, more convenient uploads from camera to

PC. Transfer hassles are the reason Sony's nice-but-not-dazzling Mavica has almost half the market today: It records pictures on a built-in floppy disk drive.

Photo enhancement software makes digital photography better, too. Adobe PhotoDeluxe, MGI PhotoSuite, and Microsoft Picture It! get better with each year's iteration, although some of the technology is dumbed down to make it more palatable to a broader cross section of users. It's easy to fix red-eye, to remove phone wires from house photos, and even to put blue skies into the picture. In recognition of the cost of good printer paper (up to 75 cents a sheet), more software lets you gang multiple pictures on a single sheet—two 3-by-5s plus four wallet photos, for example. I'm a big fan of the specialized stitching software that lets you take a batch of more or less aligned pictures and make a panorama: Live Picture's Photo Vista, Enroute's QuickStitch, and PictureWorks' Spin Panorama.

Printers themselves are better than ever, and not just \$1,000 corporate ink jets or \$5,000 graphic arts printers. This fall's crop of \$3,000 color lasers are sensational for photographic prints. So are the sub-\$300 personal ink jet printers, not

just the specialty photo printers. In fact, one VP charged with marketing his company's \$3,000-plus specialty printers says that cheap ink jet printers using good (glossy stock) paper will match or exceed the print quality of most very high-end printer.

When you're thinking about your next camera, also think about whether it should be your next video camera. I believe digital video (DV) cameras are the future. Image quality matches or exceeds Hi-8, the current consumer standard, and virtually every camera can take VGA-quality stills as well. The only downside is that the cheapest ones cost over \$1,500, making even digital cameras look cheap by comparison. **PC**



DIGITAL REALITIES

Digital photography does some things better and some things worse.

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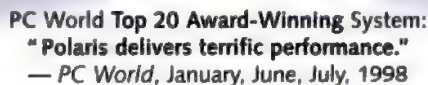
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ABOUT

WHAT TO DO

ASSESS

Look over all systems to determine your level of risk. See the section "Assessing Your Y2K Risk" on page 107.

ORGANIZE

Form a Y2K SWAT team to get everything done. See the section "A Checklist for Tackling Y2K Planning and Testing" on page 110.

PREPARE

Check with counsel at all stages to ensure you're covered legally. We've got company-wide guidelines in "Look Out for Legal Issues" on page 124.

LEARN

Understand that the basic problems are simple, but the scope is huge. See "What's the Big Deal?" on page 102.

FIX

Repair, replace, or upgrade any noncompliant hardware and software. See "Y2K Remediation Methods" for your best approach on page 122.

BY JIM SEYMOUR



Make no mistake: Year 2000 problems threaten every PC user. Some businesses and users are well

THE YEAR

SECURE

Approach your company's management to support your Y2K efforts. Get tips in "How to Talk to Management" on page 148.

TEST

Put all PCs through a BIOS and real-time clock check. See our section "Testing Your PC Hardware" for tips and a survey of tools on page 122.

PROTECT

Ask for compliance statements from all vendors whose products you use. See some examples in our table on page 138.

DEPLOY

Set up and follow a schedule to assess, test, and roll out fixes. We'll help you get started on page 146.

Your Starting Point for Everything Y2K

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Test your own PC for Y2K compliance live online, then link to Y2K compliance statements from major vendors. Check out our list of links for products to help you assess or fix things.



And tune to ZDTV in September for a special Y2K report. ZDTV is on many cable systems, plus DirectTV and other satellite systems.

DETERMINE

Be sure to ask every company you connect with if it is compliant. Start with your accounting vendor or consultant; see the section "Assess Your Accounting Software" on page 154.

LISTEN

Pay attention to warnings and advice from Y2K experts and consultants. Read about Jim Seymour's "Biggest Worry" on page 160.

SURF

Use the Web to find more important information on year 2000 issues. Start with our list of "Year 2000 Web Sites" on page 121.

REPAIR

Identify and repair year-date problems in programs and files. We surveyed several utilities that will help on page 136.

you're not, there's still time. And wherever you are in your Y2K risk assessment and remediation efforts on the PC, we've got guidelines, tips, timelines, words of warning, and a look at testing tools for hardware and software that will help.

You can't escape the horror stories about year 2000 problems. Pick up any paper, any magazine on any newsstand, or tune into TV newscasts and Sunday morning pundits' shows. They're all full of vivid stories about the impending disaster coming January 1, 2000, or, possibly more dire, Monday morning, January 3, 2000. (We should remember that this Monday is only about 450 days from now.)

There's a consistent and by-now-famil-

iar ring to these tales: About credit-card difficulties, health-care problems, jail-cell doors that won't shut, and banks that can't open. About \$100,000 phone bills or notices that you're -36 (that's minus 36)

years old. About electric-power shortages, no heating-oil deliveries (in the dead of winter), hospitals unable to function, and jobs—even whole companies—disappearing overnight.

Our Contributors: JIM SEYMOUR and GREG ALWANG are contributing editors. SEBASTIAN RUPLEY is a senior editor, and CADE METZ is a senior writer for *PC Magazine*. TOM WHITE and JIM HOLIFIELD are accounting consultants. EMILY COHEN, SHARON NASH, and ANGELA TUKA are editorial researchers. JAY MUNRO was the project leader, and GAIL SHAFFER was the executive editor in charge of this story.

BIG DEAL?

You can downplay year 2000 issues all you like, but if you use computers at all, then consider yourself "Y2K-challenged" until you determine otherwise. Year 2000 issues can take on many shapes and sizes and have a far-reaching impact.

By Greg Alwang and Sebastian Rupley

As we get closer to the millennium, Y2K will start to affect more and more noncompliant systems that use expiration dates or that use dates for forecasting. Software and computations that are date-dependent can fail outright or produce erroneous results. Some problems will go undiscovered until

it's too late and data is already corrupted. Seemingly small problems with a critical piece of equipment or application can bring a business to its knees.

Noncompliance in hardware devices and PC BIOSs can cause equipment to fail or misinterpret 21st century dates as 20th century ones. Some PC BIOSs will work after January 1, 2000 but cannot roll over on their own past December 31, 1999. Others require a BIOS fix in order to recognize any dates in the next century. The bottom line is this: If your PC's hardware doesn't recognize the date, then most software on the PC won't either (see "Testing Your PC Hardware" for more on this).

Year 2000 compliance in off-the-shelf software, custom applications, and data files is much trickier to pinpoint. Problems can be as basic as a 2-digit year

field mask or as complex as a lengthy calculation on a date value buried in a code snippet. Worse, a date problem can arise in a seemingly compliant application due to data entry, field formats, or even inconsistencies within the software.

For example, Microsoft Excel uses date windowing, whereby pivot dates are used to deal with dates input as 2-digit years. Any years input in the range 00 to 29 are assumed to be in the 21st century (2000 to 2029) and any years from 30 to 99 are assumed to be in the 20th century (1930 to 1999), but note that the pivot dates differ across Excel versions. That would be plenty to deal with in itself, but the DATE() function in Excel, when used with a 2-digit year, does not adhere to these same date-windowing rules, which produces ambiguous results. (See our example here.)

We're not just picking on Excel, either, but using it to demonstrate that even the simplest data entry can be a problem. Other programmatic Y2K issues are much harder to demonstrate, let alone

JUST A SMALL THING: In Excel 97, enter 01/01/00 and it assumes 1/1/2000. But enter=DATE(00,01,01) and it assumes 1/1/1900 (which you find out when you view it using Format/Cells/Number/Custom and change Type to m/d/yyyy).

	A	B	C	D	E
	Test	Delayed Date	Actual Date		
2	Enter "01/01/00"	01/01/00	1/1/2000		
3	Enter formula =DATE(00,01,01)	01/01/00	1/1/1900		
4	Workaround (always use 4-digit years)				
5	Enter "01/01/2000"	1/1/2000	1/1/2000		
6	Enter formula =DATE(2000,01,01)	01/01/00	1/1/2000		

WORKAROUND: The workaround in this case is always to use four-digit year dates. Here, Excel accepts the dates as you input them, no matter the format, and reads out the correct year of 2000 in both cells.

find in custom applications (see "Tools for Testing Off-the-Shelf Apps").

The year 2000 problem can and will affect most people in some way. The key is to understand the implications in your hardware and software and take the necessary precautions and corrective actions to minimize the consequences.

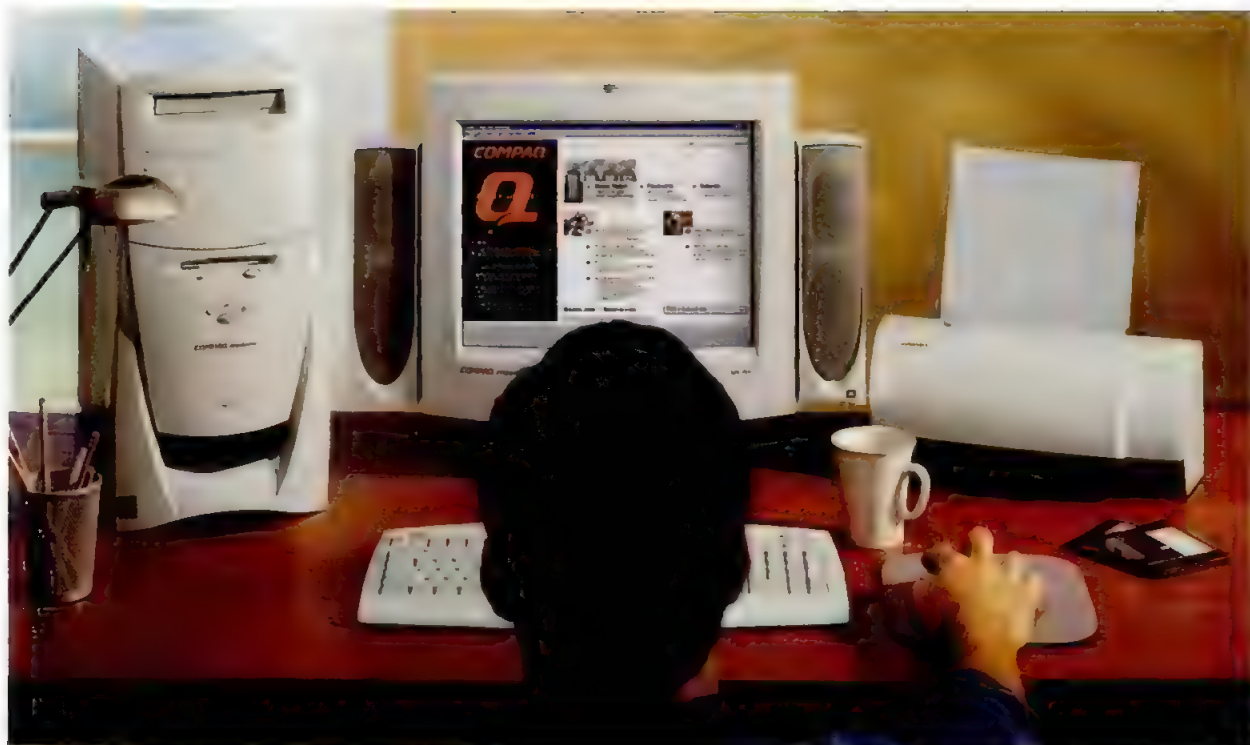
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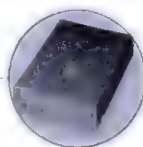
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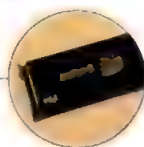
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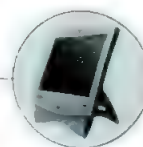
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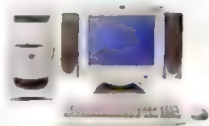
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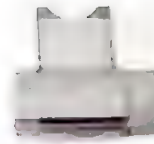
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YOUR Y2K RISK

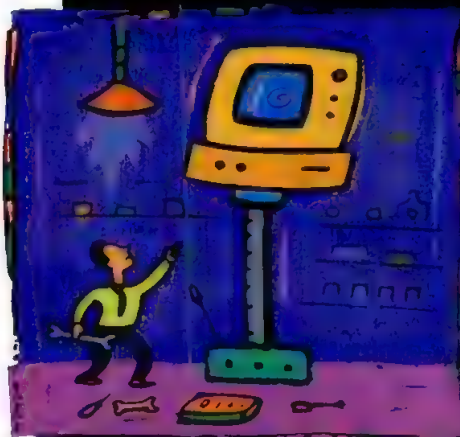
Problem ahead? Take action!

By Jim Seymour

We live in a culture with a profound bias toward action. When we hear of a problem, we tend to want to jump in right away and start fixing that problem. Hey, what's wrong with that?

Well, it's like the old "Ready! Fire! Aim!" joke: Often, we move to act before we know what we want to do. That makes the assessment phase of Y2K problem solving the least appreciated—and often the most abbreviated—part of the process.

But without a thorough assessment of a company's present computing resources and Y2K-compliance status, how can we possibly know what must be done? More, how can we set priorities until we have an agenda, a task list for the work ahead?



In an ideal world, we'd set aside equal amounts of time for assessment, repair work, and testing of that work. But with just 15 months left before January 1, 2000, we don't have the luxury of ideal planning cycles, and we should acknowledge that, messy as it may be, some parts of those cycles will and must inevitably overlap.

Y2K assessment begins with inventories—of every piece of PC and network hardware, of every commercial application in use, of every custom application in use, of every external data-communications link. With those lists in hand, we can start the triage process and make sense of it all. If the lists are incomplete, we risk

mismanaging the process, misallocating resources, mistaking our priorities.

If your business doesn't have a solid, up-to-date hardware and software inventory, which it should have anyway, begin work there at once.

From inventorying, move to gathering information about tools. Contact every hardware maker, software supplier, and third-party firm your systems connect to in the course of business. Ask for—demand politely—an up-to-date written statement of every product's Y2K compliance, specifying exact models, versions, releases.

Don't be surprised if you get evasive answers. Many vendors are even earlier in their Y2K cycle than your company (hard to believe, but true) and don't yet know what is and isn't compliant. This will be especially messy in cases of older, noncurrent hardware and software. Some vendors have excluded all but their current or most recent products, claiming they simply don't have the resources to test older products.

The lawyers are at work here, too, in many cases advising hardware and software producers to decline to produce specific assurances of compliance, lest those be held later to be warranties. So vendors either refuse to provide firm compliance data or just say their products should not be assumed to be Y2K-compliant.

Whatever data your compliance survey produces, don't trust vendors' claims. It's not necessarily that they're misinforming you, but that they can't know every detail about how you use those products; what other, possibly noncompliant products they interface with; or how well your staff has been trained to use them.

It is essential to do your own compliance testing, in your own computing environment, in addition to seeking vendors' compliance statements.

After that testing, you'll move to remediation: upgrading existing software to later releases, or perhaps replacing it with alternative products; replacing

hardware, or upgrading it through flashing older BIOSs, or physically replacing it; updating custom apps in use in your company; and—ouch!—examining all the spreadsheets, databases, and other date-field-dependent records.

Every decision in that food chain depends on the accuracy and thoroughness of your assessment. Overlook a few critical spreadsheets used by production or bidding people, miss a couple of notebook PCs in need of BIOS upgrades, or forget about a network router, and you'll still be at risk.

Even this late in the game, assessment may well take up as much as a quarter of the time remaining before we reach January 1, 2000.

Trust us: It's worthwhile. Assessment may be time-consuming, dull, and unsexy, but it's the cornerstone of fixing your Y2K problems.

Get Going

From a survey of 15,000 companies in 87 countries for a July 1998 report:

23% of all companies have not started year 2000 efforts. More than **80%** of these are small companies.

19% of the companies that have started compliance efforts began face-to-face meetings in 1998 with vendors that provide mission-critical IT solutions. These meetings are required, because survey letters have proven to be an inaccurate assessment method.

50% of all companies do not intend to perform year 2000 testing, because they plan to fix and install code to production systems.

Source: Gartner Group

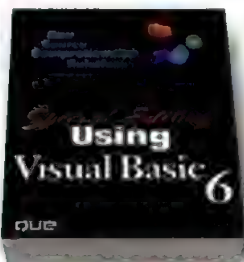
THE Computer PAGE.

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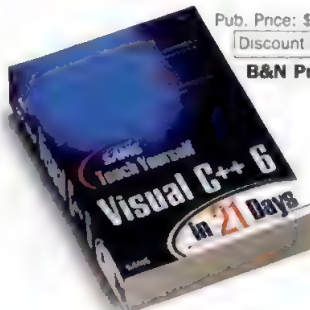


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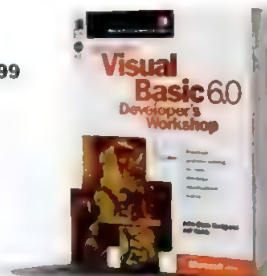


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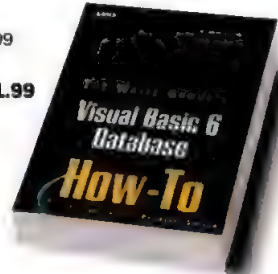
by Eric Winemiller, Jason Roff,
Bill Heyman, & Ryan Groom

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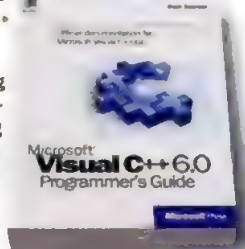
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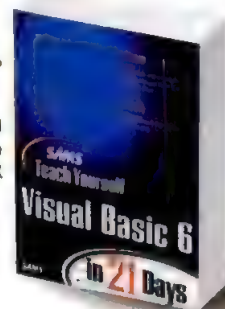
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It's not just the U.S. press. Go online and sample major newspapers and magazines from around the world—Canada, Australia, Thailand, Ireland, France, New Zealand, Iceland, Brazil, you name it: They're all telling the same stories. Or ones that are even more frightening: predictions of no food on store shelves in big cities, riots in the street. The end of life as we know it.

Surely there's some exaggeration there. It can't be that bad. It won't affect your PC and mine, right? And certainly we know how to fix this stuff, huh? Or somebody does, right? We surely *will* fix it in time. Won't we?

Yes, there's a lot of exaggeration in the press about the possible consequences of Y2K-related failures. A mini-industry has arisen, devoted to worst-case analysis. And some fear these will become self-fulfilling prophecies, if only by frightening us out of fixing Y2K problems.

There's likely also some truth in many of these predictions: that banking, security, health care, distribution, energy, telecommunications, and other critical industries

will suffer at least some disruptions; that investors, management, and workers will wind up in court over unresolved Y2K issues; and that there's a fair chance both the U.S. economy and the world economy will shudder while problems not solved by January 1, 2000, are being fixed.

Starvation? Financial collapse? Darkness at noon? Not likely. Possible, to be sure, but none of those is in the "probable" column. As long as we do what we need to right now.

In this article, *PC Magazine* lays out the practical territory for you: what you can and need to do to assess and take care of year 2000 problems you may have on your PC desktops and servers. These problems can show up in your systems' internal hardware clocks, in OSs, and in software programs. They are most insidious in some spreadsheets, databases, and files that you may have built and customized for yourself over the years and which now may have date-calculation problems when they hit the year 2000 rollover.

Besides performing surveys of testing

tools for both hardware and software, we've pulled together tips and strategies on how to assess your risk and how to plan and carry out testing, ideas on which approach to consider for fixing things, recommendations for how to talk to management about these potential problems, thoughts on legal considerations, sample timelines to follow from here on out, and lots, lots more as well.

THE ROOTS OF THE PROBLEM

By now nearly everyone who uses a computer, and almost everyone whose life is touched by them, has heard about the Y2K problem, and its origins. It's simple enough to understand technically, though fixes have proven very difficult. (See "What's the Big Deal?")

In the 1960s and 70s, as computer use exploded, both memory and storage were very expensive. Writing programs in ways that minimized the amounts of memory and storage used was important. So programmers, usually working in COBOL, then the lingua franca of the business

A CHECKLIST FOR TACKLING Y2K

STEP BY STEP

By Greg Alwang

Assemble a Y2K-contingency team.

- ☐ Be sure management, key business units, and departments are all represented. You must especially have top-level management support.
- ☐ Make it clear that Y2K compliance is a critical business function and that all meetings, tasks, and decisions must be documented (for legal reasons).

Have a Y2K compliance kickoff meeting.

- ☐ Define the purpose of the Y2K-contingency team and each member's role.
- ☐ Make sure members are brought up to speed regarding Y2K issues, definitions of Y2K compliance, and what they should look for. Urge them to raise awareness at all levels within the company (this will help the overall effort).
- ☐ Develop your company's own definition or statement of Y2K compliance based on

your business and how it uses its systems.

- ☐ Identify goals, determine a preliminary schedule, and plan to meet regularly to review Y2K progress.

Inventory all systems and applications.

- ☐ Compile a list of all hardware, software, peripherals, systems, applications, and data that could be affected by Y2K dates. Software tools can assist with this step.
- ☐ Be sure to include external systems or organizations that affect these internal systems (for example, EDI systems, data shared with third-parties).
- ☐ Keep this inventory as your documented starting point (for legal reasons).

Assess risks and prioritize affected systems.

- ☐ Bear in mind the definition of compli-

ance for each system or application and assess the business value of each system. Software tools can help with determining application compliance.

- ☐ For accounting systems, enterprise resource planning (ERP), and large, customized systems, check with the vendor regarding Y2K compliance.

Find out the Y2K-compliance status of your vendors, distributors, suppliers, and large customers who could have a direct impact on your business.

- ☐ Prioritize your needs according to criticality. Keep the time constraints in mind and identify which systems must be fixed before Y2K and which can wait (in many cases, you won't have the resources to fix everything in time).

Determine your Y2K-compliance budget.

- ☐ Develop cost and resource estimates

world, hit on the idea of using just two digits to record years in dates, so that 59 stood for 1959. A phenomenally large percentage of computer operations rely on date calculations, and cutting the amount of space occupied by year-dates in half seemed like a good idea.

This convention was carried forward, even when both memory and storage costs began to plummet in the 1980s, as new generations of computers, software, programmers, and PC users arrived. No sane person would think 59 in a computer database or spreadsheet field meant 1859—nor, certainly, 2059. In short, the shortcut created few problems.

But by the early 1990s, cracks began to appear. Boeing was the first major company to report problems: Date calculations suddenly became problematic, as the ending date of stored or calculated time periods began to fall into 2000 and beyond. Some spoke out about approaching problems, but little happened.

By 1995, consciousness of what quickly became known as “The Y2K Problem,”

and less accurately as “The Millennium Bug,” became more widespread. Still, though Y2K was a great topic for speculation, few companies took action. This would go away, right? And if it didn’t, their programmers could fix it easily enough. After all, you just had to put a 19 or 20 in front of those two-digit years to make things work, right?

By the middle of last year, that view had changed forever. Many companies had begun formal Y2K review and remediation programs. Y2K had become a constant topic at computer forums, conferences proliferated, and consultants came out of the woodwork. And that “sky is falling” stuff began to appear in the business and popular press.

But there was a problem: Y2K issues had turned out to be deeply embedded in the systems of businesses worldwide, and very resistant to quick fixes. It became evident that the problems wouldn’t be fixed, at least not all of them, in every company and public institution, by December 31, 1999.

IT GETS WORSE

A rational approach to Y2K analysis produces—at minimum—a three-year timeline for assessment and repairs in many businesses: a year to assess, a year to fix, a year to test. Although that timeline might be shortened for very small businesses, in many companies even three years was an optimistic guess. Anyone who’s worked in system analysis and development knows how unreliable project completion dates are.

Today, with about 15 months left before the arrival of the year 2000, few companies and public agencies are in good shape with their Y2K efforts. Many began assessing their Y2K exposure only this year, and have already realized that completing their Y2K-compliance work by the end of 1999 is impossible. (See our suggestions with this article for helping you sketch out your own time line.)

For the majority of businesses and agencies, triage has become the buzzword: an acknowledgment that many things will go unfixed (in time for the

PLANNING AND TESTING

for assessing your risk.

- ☐ Develop cost and resource estimates for fixing the affected systems.
- ☐ Plan on conducting a short pilot project (4 to 6 weeks) on a small system to get a feel for the time necessary to make a system compliant.

Formalize and begin Y2K remediation and testing strategy.

- ☐ Identify a testing team (in-house or out-source), develop testing plans, and determine requirements for each system.
- ☐ Document each task to avoid duplication and missed steps.

Acquire and identify fixing and testing tools and resources (automated tools whenever possible).

- ☐ BIOS tools for PCs
- ☐ Application-testing software for some applications

- ☐ Special-purpose testing software for custom applications (such as COBOL)
- ☐ Y2K consultants, programmers

Carry out testing.

- ☐ Develop baselines and testing scripts (more rigorous testing for mission-critical systems)
- ☐ Regression testing (did the team create any new errors in the system?)
- ☐ Development testing (Do the Y2K changes meet coding specs and perform as outlined?)
- ☐ Y2K-compliance testing (Do the changes work after January 1, 2000 and with Y2K leap-year date?)
- ☐ Future-compliance testing (Do the changes work with all dates after January 1, 2000?)
- ☐ End-to-end testing (Do the system and its related systems still meet the business process requirements?)

- ☐ Assess results, (refix if problems still exist)
- ☐ Retest systems

Prepare a disaster recovery plan.

- ☐ Develop a temporary solution for mission-critical applications in case you don’t finish in time. Build in redundancy to the most critical apps.
- ☐ Establish a SWAT team to get mission-critical systems and applications back up and running immediately if they do fail.

Sign off on acceptance of compliant systems.

- ☐ Get a sign-off from the responsible Y2K contingency team member, department manager, and vendor contact, if applicable.

Follow up and maintain Y2K compliance.

- ☐ Use available metering software to ensure that no new, noncompliant applications are introduced.

rollover, at least), with the focus on getting the most critical systems working properly by the end of next year. Then, perhaps, there'll be time to go back and fix the rest of the problem.

Worse, some companies are finding that Y2K problems can arrive long before the year 2000 does. Although many credit card problems have been addressed, you still hear about the occasional situation in which a card with an expiration date after January 1, 2000, creates problems or even freezes a store's computers.

And then there are other distractions: conversion to the new Euro currency standard; the "10K" problem among Wall

Eyes Wide Shut

From a CIO magazine survey of 643 individuals for a Year 2000 Consumer Awareness Study in May 1998:

38% admit they're not aware of the year 2000 problem.

62% know about the problem.

Of the 62% with working knowledge of the problem: **50%** are not at all concerned about Y2K affecting them personally, and

80% are confident the problem will be fixed before the dawn of the millennium.

Yet CIO's April 1998 poll of technology and business executives indicated that only **17%** were confident the glitch would be fixed in time.

Source: CIO magazine

Street firms, whose program-trading software, written in the mid-1980s, can't handle a Dow Jones Industrial Average of 10,000 and beyond; and the nasty "four 9s" problem, created by generations of programmers who used the date 9-9-99 in their code and test records as a kind of shorthand message for *invalid* or *ignore*.

The cost of these fixes? No one knows, but estimates range up to \$1 trillion. (And this doesn't even take into account the legal mess that seems to be brewing—be sure to see our sidebar "Look Out for Legal Issues.")

THE VIEW FROM THE DESKTOP

One of the enduring myths about Y2K is that the problems are all mainframe- and minicomputer-related; that PC hardware and software that didn't exist in those bad old COBOL days are immune. Wrong, wrong, wrong. PC problems may be secondary to the huge problems with older hardware and software but are nonetheless present, critical, and daunting to solve. Moreover, as PCs have become ubiquitous in business and government, they have also become more and more critical to the health and function of those entities.

Put simply, if we fix every mainframe and minicomputer hardware and software problem by the end of 1999 but don't fix the PC desktop side of the equation, we're still in big trouble.

PC problems occur in four areas: the BIOS chips that control the basic functions of PCs; two-digit code in commercial PC software; our own habit, over the years, of entering two-digit-year dates in PC spreadsheets and databases, even when four-digit entries are possible; and the embedded code in the hardware and software that glues together our PCs in networks—in servers, network operating systems, bridges, routers, and switches. Our use of PCs and PC networks also depends on external factors, such as the availability of power and telecom links.

At *PC Magazine*, our Y2K focus has been, not surprisingly, on the PC side of the problem. What we have found is unsettling, because our discoveries suggest the problems are deep, complex, intractable, and slow and expensive to fix.

It's disconcerting to discover that some PCs manufactured as recently as 1997 have Y2K-noncompliant BIOSs. In some cases, PC BIOSs can be *flashed*—overwritten with updated code—to solve the problem. In others, new, compliant BIOS chips are available and can be installed by users or their support departments. But no one should assume a given PC or other computer hardware is okay without running validation tests and seeking compliance information on that specific model from its manufacturer. (See "Testing Your PC Hardware" later in this story.)

It's also worrying that PC software makers, while finally responding with internal test-and-validation programs, have sometimes misrepresented the true

state of Y2K compliance in their products. They have simply written off a wide range of recent (if not current) products that are still in wide use. Microsoft, for example, says that both Office 4 (Standard Edition) and Office 97 are Y2K compliant. But you can get into trouble with Access and Excel. What's worse, the problems and their solutions vary from version to version. The safest approach is to upgrade to the latest version of all essential programs, seek compliance statements on those specific versions from their publishers, and run validation tests to confirm compliance claims.

Don't assume that, say, routers don't use date calculations and must be inherently safe. Even when date calculations are not part of a system's functions, dates are often used invisibly to confirm versions, to control flash upgrades, and to manage automatic diagnostic routines. If a router's code encounters a date it does not understand, or misunderstands, it may well simply lock up, bringing the network to a halt. Get compliance information and run your own tests on every piece of computer hardware in your shop—and every piece of power-control equipment (such as UPSs and their software) and telecom equipment as well.

Finally, there's the problem of—well, *you*. As Pogo said, "We have met the enemy, and it is us." When we build spreadsheets and enter dates as 06/21/98 (or 98/06/21), we build in a systemic problem that can be incredibly hard to find and fix.

If a company has 500 PCs, 6 commercial applications, and 35 internally developed apps, running on 20 servers, with 12 switches, bridges, and routers, that's a very tough but manageable assessment-and-repair project. But if each of those PCs has produced on average 10 spreadsheets and 5 databases, each with 50 date entries, the fix spirals out of control. Users can't be expected to discover and fix these problems on their own. Central MIS staff must see that every worksheet, every database, every date entry is examined and fixed.

That can be a devastating load, especially with a 15-month deadline, at best.

INTERCONNECTS

In the 1950s, the futurist Buckminster Fuller told us about "the interconnectedness of everything." Bucky is better remembered for geodesic domes, but solv-

ing Y2K problems will recall for many his warnings about the interrelatedness of our world. The complexity of solving "whole system" computer issues, of assuring that not only the individual pieces of a system but all the hardware and software used to connect those pieces is Y2K-compliant, is enormous.

And then there is what may be the biggest risk of all: the reliability and compliance of every system your system connects to. Even if you fix everything in your company, if the computers at your just-in-time suppliers' sites fall short of Y2K compliance, you're going to have trouble.

It's tough to build cars without fenders and batteries, but that may be what GM will face if even a few computers in the web

of external systems the manufacturer connects to fail. Worse, perhaps, is the possibility that you believe those external systems are functioning properly (when they aren't) and unknowingly build unreliable data from them into your calculations, or suffer corruption of your records.

For many experts, this issue of the real Y2K problem extending well off your premises is the most difficult and frightening of all. Though few companies will have all their own systems fixed by the end of 1999, even those who do are at great risk of problems, perhaps serious crises, from bad data originating in networked non-compliant systems.

Whatever the dimensions of the social problems that may arise from Y2K fail-

ures (see "My Biggest Worry"), your work starts at home: assessing the readiness for the next century of your PCs, software, and networks. Then, we can each urge everyone else to fix their systems—Bucky Fuller's words will ring in our ears long after January 1, 2000. But your own job right now is to start fixing the problems on your own desk, in your notebook, on your network, and in your spreadsheets and databases—and don't forget about your home office either.

It's a mess, to be sure, and a massive undertaking. But the consequences of Y2K-compliance failure are likely to be a much bigger mess and could dwarf what we're facing this minute—if we don't all take action right now.

WEB SITES

The quantity of Web sites dedicated to Y2K issues is not a problem—the quality is. Every major hardware and software vendor has a page dedicated to Y2K issues, which is a good thing. Some sites start with a definition of Y2K and end with links to solution providers. Others are mere portals to Y2K resources on the Web. Here, we give you a sampling (in no particular order) of some Web sites that might help you on your quest for Y2K answers.

By Greg Alwang

www.pcmag.com/y2k

PC Magazine's Year 2000 Resource Center is full of links to vendor Y2K policy pages and other resource sites. It has up-to-date information about Y2K testing and analysis tools as well as utility downloads, vendor and package compliance information, a discussion area, opinion columns, and technical articles, plus an exclusive online utility for testing your own PC's Y2K compliance.

www.zdnet.com/y2k

Ziff-Davis's ZDNet Special Report page, Year 2000 Challenge, contains Y2K news updates, commentaries, survey results, case studies, and links to other resource sites. You can subscribe to an e-mail update service or join Y2K discussions.

www.y2knews.com

The online version of Y2K News Magazine covers everything Y2K, from the general to the socio-economic. It provides daily updates of worldwide Y2K news and includes an extensive archive of Y2K articles. Y2K News also includes threaded discussion forums and a Y2K chat room.

www.year2000.com

The Year 2000 Information Center is sponsored by Y2K expert Peter de Jager. This site is designed to raise awareness about the Y2K problem. It includes links to late-breaking news articles, vendor sites, job classifieds, and user groups, as well as educated insights into how to deal with your own Y2K problems.

www.yahoo.com/computers_and_internet/year_2000_problem

Yahoo's year 2000 problem portal page includes links to current news stories and sources, Web sites, and message boards.

www.itpolicy.gsa.gov/mks/yr2000/y2khome.htm

Designed to help Federal agencies meet the Y2K challenge, the U.S. Government's gateway site for Y2K information directories provides links to results from research by the Chief Information Officers Council, including articles, best practices and FAQs, databases of software compliance, and timely results from the International Y2K Virtual Conference.

www.garynorth.com

Gary North provides a no-holds-barred pessimistic view of the Y2K problem, along with dozens of links to articles and papers backing his opinions on the subject. If you come across any skeptics in need of an eye-opener, send them here.

www.mitre.org/research/y2k

With information provided by the Air Force Materiel Command and maintained by Mitre Corp., this site contains a complete description of the Y2K problem, including how to take action, details of the five phases of compliance, tips on attaining Y2K certification, lists of solutions and providers, information on

contingency planning, and links to other resources.

www.state.pa.us/Technology_Initiatives/year2000.html

A good example to all state governments, Pennsylvania's Y2K site explains the problem and how the state is working toward educating businesses, universities, and local governments to deal with it effectively.

www.zdnet.com/pcweek/y2k/y2k.html

PC Week's Y2K Watch page offers a collection of resources, archived product reviews, articles, and strategies.

www.y2k.com

This site specializes in Y2K legal and management issues and includes sections on liability, legal FAQs, and links to vendors and services. It includes online presentations covering such topics as the role of legal counsel during the remediation process and how to rate your Y2K liability.

www.y2kinvestor.com/intro.html

Hosted by radio talk show host Tony Keyes, the Y2K Investor site focuses on Y2K issues as they relate to the financial and investment markets. It includes pointed discussions and documents on the state of Y2K affairs in finance, government, transportation, utilities, and the global economy.

www.bug2000.co.uk

A product of the British government wing Action 2000, Bug 2000 was created specifically to handle Y2K issues. This Web site contains links to a product-compliance database, a list of steps for addressing the problem, legal issues, and articles.

TESTING YOUR PC HARDWARE

Test Your PC Live Online

www.pcmag.com/y2k

Of 10,000 users who have already tested their PCs, 20 percent have found their PCs noncompliant.

Check out our links to Y2K compliance statements for top vendors and to other testing tools, discussions, and more!

By Cade Metz

Rest assured, Armageddon will not arrive via your PC BIOS. You may have difficulty finding year 2000 glitches in critical applications or stored data, but such problems in your BIOS are, for the most part, easily detected and repaired. Because

BIOSs provide operating systems with the current time and date, this is particularly fortuitous. No matter what difficulties abound on January 1, 2000, you can at least ensure that your PC's central clock and calendar are correct.

This is not to say that BIOS-based year 2000 glitches will go unnoticed if you fail to correct them. Though most (but not all) machines sold within the past two or three years will recognize the year 2000 on their own, the average older PC isn't so adept. When booted anytime after December 31, 1999, its BIOS will assume that the year is 1900 and pass an incorrect date to the operating system.

DOS, Windows 3.x, and Windows 95 are incapable of recognizing this problem and will in turn pass the wrong date to

your vital applications. But even if you're running Windows NT or Windows 98—which are more aware of the problem—you aren't entirely out of the woods: Many applications bypass your operating system to retrieve the current time and date.

Here, after examining the nature of this problem, we guide you through several methods of ensuring that your BIOS is year 2000-compliant. Typically, you can solve the problem on your own, without additional hardware and software. This fix, however, cannot be used with a small fraction of machines and is impractical if you're dealing with a large number of systems. We show you not only how to implement the fix but also how to recognize whether you'll be able to use it. For those who can't use it, we also review ten third-party fixes.

Whatever your situation, the best solution is to obtain a BIOS upgrade. Before doing anything else you should contact your PC manufacturer to ask if your

METHODS

Once you determine that you have Y2K problems in your applications or data, how do you go about fixing them? Your approach will depend on several factors, including the nature of your Y2K problems, the age and type of your systems, whether you're using off-the-shelf or custom software, your budget, and the amount of time you have before Y2K catches up to you.

By Greg Alwang

Before you fix anything, take a close look at your systems and the types of Y2K problems they have. Then apply risk-assessment techniques to prioritize the issues by criticality to your total business function. Then, choose a remediation methodology that makes sense for you. Techniques vary widely and carry different risks, but they generally fit into three categories: replacement, reparation, and encapsulation.

Replacement means replacing all or parts of a system—sometimes both hardware and software. It sounds drastic, but for large, complex systems, it is often the most cost-effective solution. The greatest problems here are the lead time involved and the expense. At this point, replacement may be viable only for

smaller businesses.

Reparation involves fixing Y2K problems in place through recoding, upgrades, or patches. Recoding can mean expanding data field masks, editing date-related computations, and writing special-purpose programs or workarounds to bridge noncompliant systems and compliant data. If the data itself is noncompliant, reparation can involve data structure changes and data conversions.

Recoding of a very large system can cost as much as or more than replacement, so accurate assessment is a must. Instead of recoding, some businesses opt for a temporary fix called date-windowing, wherein systems assume the century based on a 2-digit year range. For example, 00 to 29 stand for 2000 to 2029 and 30 to 99 stand for 1930 to 1999. For the most part, reparation through coding or data manipulation can be risky and expensive because of the greater potential for introducing new errors.

Encapsulation entails either shifting data information back 28 years across the board or modifying programs to run ahead 28 years (it's 28 years because the same weekly/daily calendar repeats

every 28 years). The system still operates correctly on real dates, but behind-the-scenes date manipulation keeps the Y2K problem in check. Because only one element is changed (data or programs), many businesses see this solution as less risky and less costly than full reparation. Like date-windowing, this is a temporary fix and generally used only on systems with massive amounts of old data files. At some point, you'll need to double-back and really address the problems.

Of course, you could also opt to just wait things out and fix whatever fails after the rollover. This approach certainly carries the most risk to uninterrupted business operations and could put you in legal hot water.

In some cases, a simple software upgrade or requirement that all data be entered using 4-digit dates may do the trick. We outline a few scenarios in the graphic here and give you some guidance on which remediation technique might be appropriate for you.

Whatever method you choose, be sure you understand the risks and costs, and always develop a comprehensive plan before diving into Y2K fixes.

Y2K REMEDIATION

that the year is 1900. Depending on what OS you're using, this error will have varying effects. Windows NT 4.0 and Windows 98 will recognize that the date is incorrect and automatically change it for you, but older OSs—such as MS-DOS, Windows 3.x, and Windows 95—will assume that the date is either January 1 or January 4, 1980 (the earliest dates they are capable of handling). Windows NT 3.51 can recognize dates prior to 1980 but can't correct the year 2000 glitch on its own (though Microsoft claims that a fix for Windows NT 3.51 will be available this fall). But, regardless of what OS you're using, you must make sure that your BIOS and RTC report the correct date.

TESTING YOUR BIOS FOR COMPLIANCE

Though we recommend testing your machine for year 2000 compliance using a downloadable utility such as the one offered on ZDNet's Virtual Labs Web site, you can easily do these tests on your own. This may not be the most efficient method, but it is the best way of understanding how to correct the problem. Many means are available (see "Testing for Year 2000 Compliance"), but here we detail a method that uses a DOS boot disk. Under Windows 95, you can create such a disk by selecting Add/Remove Programs under the Control Panel, accessing Startup Disk, and clicking on the Create Disk button.

To begin this test, insert the boot disk into your floppy disk drive, power up your system, and type "date" at the A: prompt. DOS's Date command has two functions: It displays the current date and then prompts you for a new one. When prompted, type in December 31, 1999 (12-31-1999). This changes not only the date in the OS clock (here, the OS clock kept by your boot disk), but—via the BIOS—changes the date within the RTC as well.

Next, type "time" at the A: prompt and set the time to 11:59 P.M. (23:59). Much like Date, Time sets the OS clock and then changes the time in the RTC. Now that the RTC thinks that the year 2000 is only sec-

FOR LEGAL ISSUES

The year 2000 problem is turning into the lawyer's full employment act. It's hard to find a midsize or larger plaintiffs' law firm in the U.S. that isn't preparing for the avalanche of litigation expected.

By Jim Seymour

And the beat has already begun: At least ten suits have been filed under the Y2K banner. This includes a well-publicized action against Quicken, complaining that the company is expecting users of its products to buy Y2K-compliant upgrades rather than its replacing every older, noncompliant

software vendors for the alleged failure of systems. Consulting firms and VARs that recommended and installed equipment will be among the defendants. Businesses will sue other businesses whose computers interfaced with theirs, claiming data corruption. Power and telecom utilities will be the targets of huge actions, with claims of losses from power outages that could have been avoided, plaintiffs will say.

Shareholders will sue company directors and officers for failures to anticipate and fix Y2K failures. Brokerage firms and the banking industry will face suits over failures to fix problems before investors' and depositors' records and assets were trashed—or at least made inaccessible for too long.

It's going to be a mess. And this isn't just "the sky is falling," but a claim that comes from the likes of the American Bar Association Journal, which warns of "massive litigation arising out of a disaster of unimaginable proportions."

What can your firm do now to avoid being the target of legal actions or at least to mitigate the damages that might be assessed against you?

First, document, document, document every step you take to determine Y2K risks, fix those problems, and alert customers and businesses you work with to the possibility of Y2K-caused interruptions and errors.

Second, consider a formal Y2K audit

by a major accounting or consulting firm. These audits tend to be generalized and often are not sufficiently specific for action. But an audit may provide a good-faith defense later on, by attaching the name of a respected third party to your efforts.

Third, hire Y2K-savvy counsel now to review your business's procedures and build protection against Y2K lapses into contractual agreements.

Fourth, report compliance-assessment results directly to your board of directors and institute a formal status-update policy for those directors and for company management as a whole.

Fifth, make sure senior management, from the board down, communicates to all employees that early, certain Y2K compliance is a top priority.

Sixth, put in place an emergency plan to be used in the event of system failures on or after January 1, 2000—or sooner. This plan should cover temporary alternative systems and procedures that can be used to bypass crashed, noncompliant systems.

Finally, make every employee conscious of the liability issues the company faces in the event of major Y2K failures and the implications of those failures for the company's financial health and its continuing viability.

You can't eliminate the risks of Y2K, but you build a defense against the consequences of Y2K failures.

LOOK OUT

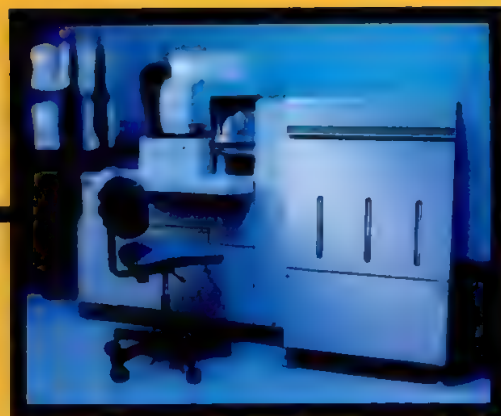


Quicken product in use.

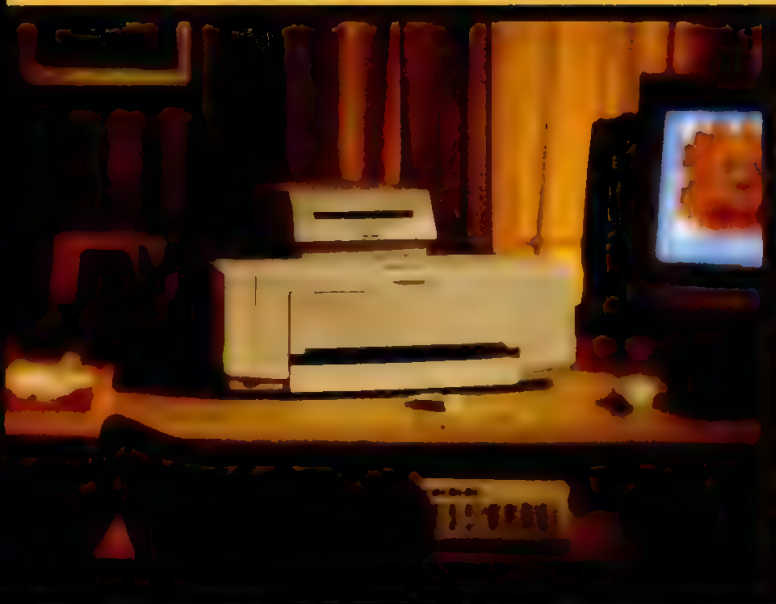
It is estimated that litigation caused by real and claimed Y2K failures will cost up to \$3 trillion worldwide. And these law suits will be multidimensional and will go in many directions.

Companies will sue hardware and

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The Clocks of the Common PC

- 1 The RTC (real-time clock),** which resides on a chip on the motherboard, automatically keeps the time and date
- 2 The BIOS,** which resides on a ROM chip on the motherboard, reads the time and date from the RTC and passes them to the OS
- 3 The OS clock,** within your operating system, keeps time for all loaded applications

onds away, turn off your machine and wait at least a minute. Within that minute, the RTC's year register will roll over to 00 and the century register will remain at 19. After again booting the machine to your floppy disk, return to the Date command.

If the year reads 1980, then you have a problem. The BIOS has received a 1900 from the RTC and passed it on to DOS (which has defaulted to 1980). If the year reads 2000, then you likely do not have a problem. Your BIOS has changed the century register to 20 and will pass the year 2000 to your OS. Typically, this means that Read Real-Time Clock Date has been modified to change the century register to 20 if a value any less than 80 has been read from the year register.

You don't need a boot disk to perform this makeshift test. You can also use your BIOS setup screen or your loaded OS to test the year rollover. But we don't recommend using your loaded OS. If you set your main OS clock forward to the year 2000, your software licenses could prematurely expire. For this reason, you must always set the RTC back to its original values after using a boot disk or BIOS setup to test your system for compliance.

OTHER POSSIBLE GLITCHES

With most PCs, the only problem you need to check for is the rollover from 1999 to 2000. But there are a few exceptions. During the brief window from April 26, 1994 to May 31, 1995, Award Software sold a BIOS that incorrectly reads the RTC and assumes, every time you boot up, that it's still the 20th century—no mat-

ter what the century register contains. Furthermore, some RTCs may lack century registers entirely. If your machine has either of these problems, run the test again with a slight change: Instead of setting the date to December 31, 1999, set it to January 1, 2000 (or any date in 2000). This will ensure that your RTC has a valid century register and your BIOS can properly read it.

Many pundits are also saying that machines may have problems recognizing that 2000 is a leap year, but this is merely urban legend. The standard RTC architecture automatically provides a 29th day at the end of February in every year divisible by four and will do so for the year 2000. But, if you still want to check your machine

ter, then you must upgrade your BIOS or use one of the third-party fixes reviewed below. If your PC is merely unable to recognize the change from 1999 to 2000, you can implement a fix on your own: Wait for the year 2000 to arrive, change the RTC's century field to 20, and reboot.

You can change the RTC's century field via the Date/Time icon within Windows 95, but we don't recommend this method (booting your machine with the RTC set to the year 1900 could also cause software licenses to expire). Instead, you should change the date via a DOS boot disk or your BIOS setup before 1900 gets passed to your main OS clock. The procedure is, in each case, simple (see "Correcting the Year 2000 Problem"). After changing the century register to 20 (via BIOS setup, a DOS boot disk, or your main OS), the date will be correct when you reboot.

The only caveat with this correction is that it isn't immediate. Administrators of large PC networks—who may have difficulty correcting hundreds of machines on January 1, 2000—should consider a third-party fix or a BIOS upgrade.

COMMERCIAL TESTS AND FIXES

If you're uncomfortable with doing your own tests, several companies are providing software and hardware that can handle BIOS-based year 2000 glitches for you. For the most part, the software solutions execute tests similar to those above then pro-

Real-Time Clock Registers at the End of 1999

11:59:59 P.M. on December 31, 1999	Seconds	Minutes	Hour	Day	Month	Year	Century
	59	59	23	31	12	99	19
The first six registers update automatically. The last register does not.							
	59	59	23	31	12	99	19
	59	59	23	31	01	01	00
12:00:00 A.M. on January 1, 2000	00	00	00	01	01	00	19

for leap-year compliance, run the test we outline a third time, using February 28, 2000 rather than December 31, 1999.

CORRECTING THE PROBLEM

If your machine suffers from the Award problem or its RTC lacks a century regis-

vide a fix in the form of a TSR—a simple DOS routine. The hardware solutions, which ship with simple software testers, are essentially ISA cards that fix the problem by providing an extension to your BIOS.

Certainly, you need not buy a software package merely to test your system. You



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Testing for Year 2000 Compliance

VIA A DOS BOOT DISK:

1. Insert a boot disk (see your OS documentation) into your floppy disk drive and power up your system.
2. Type "date" and change the date to December 31, 1999 (12-31-1999).
3. Type "time" and change the time to 11:59 P.M. (23:59).
4. Power the system down.
5. Wait at least 1 minute.
6. Reboot from the floppy disk and type "date".
7. If the year doesn't read 2000, then you have a problem.
8. Use Date and Time to reset the current date and time.

VIA YOUR BIOS SETUP:

1. Enter the BIOS setup at boot time (see your PC's documentation).
2. Change the date to December 31, 1999 (12-31-1999).
3. Change the time to 11:59 P.M. (23:59).
4. Power the system down.
5. Wait at least 1 minute.
6. Power the system back up and reenter the BIOS setup.
7. If the year doesn't read 2000, then you have a problem.
8. Use the BIOS setup to reset the current date and time.

VIA WINDOWS 95 (NOT RECOMMENDED):

1. Boot to Windows and access the Date/Time icon under the Control Panel.
2. Change the date to December 31, 1999 (12-31-1999).
3. Change the time to 11:59 P.M. (23:59).
4. Power the system down.
5. Wait at least 1 minute.
6. Power the system back up and return to Date/Time.
7. If the year doesn't read 2000, then you have a problem.
8. Use Date/Time to reset the current date and time.

can use one of our manual methods or, better yet, one of the many free utilities available on the Web. Of these, we recommend the McAfee 2000 Toolbox checker, available from our Virtual Labs Web site (www.zdnet.com/vlabs/y2k/testy2k.html). This utility is particularly attractive because it uses a VxD under Windows and does not ask you to reboot your system.

Only after finding a problem should you consider purchasing a commercial product. If your machine suffers from the Award problem or you wish to fix the rollover glitch immediately, then a TSR fix is worth implementing. Launched at start-up via your Autoexec.bat file, these TSRs typically check to see if the BIOS has read

a date prior to 1980 from the RTC. If this is the case, then they add 100 years to the date before passing it on to your OS.

The **Y2K PC Pro PC Hardware Year 2000 Fix and Diagnostic** from The RightTime Clock Company (305-577-6412, www.righttime.com) typically sits on a single floppy disk (though it can be obtained via e-mail) and runs under DOS, Windows 95, or OS/2. It performs two quick tests (which involve rebooting your machine) then installs a TSR fix if the tests fail. Pricing for the fix begins at \$30 (list) per tested machine (minimum ten) but goes down as you increase the number of machines. Not only does this solution realize that the leap year problem is bogus, but it also offers a utility that dynamically displays the current values kept by the RTC and the OS clock, allowing you to understand the nature of the problem visually.

The **2000 Wizard** from DMX II (877-367-3692, www.dmx2.com) is a similar single-disk DOS solution, though it lacks a viewing utility. For \$39.95 (list), you can test five machines and fix but one (though prices go down if you buy in bulk). A third DOS utility, the **Millennium Bug Toolkit** Hardware Tester and Fixer from Computer Experts (UK) Ltd., (+44 (0) 1-273-696-975, www.computerexperts.co.uk), is not as easy to use as these packages and is priced at \$83 (list) for a single-user license, but its TSR fix is as good as any other.

UniComp Products (770-424-8645, www.unicomp-products.com) provides **Date-A-Fix**, initially priced at \$49 (list) for a single-user license. This utility doesn't label its tests well, but it does allow you to uninstall its TSR fix easily. To uninstall the fixes provided by the three DOS utilities above, you must manually edit your Autoexec.bat

Network Associates (800-332-9966, www.nai.com) offers two Windows products: **McAfee 2000 Toolbox** (\$29.95 list) and **Nut & Bolts 98** (\$39.95 list). In addition to scanning your data files and applications for year 2000 bugs, McAfee 2000 Toolbox also runs the de rigueur BIOS checks (using the same code available at Virtual Labs) and implements a TSR fix. Nuts & Bolts 98—an eclectic package for managing, optimizing, and analyzing your PC hardware and software—includes basically the same TSR and BIOS-checking code as the McAfee 2000 Toolbox but does not—as its sister package does—permit you to

uninstall the TSR with ease.

A TSR is not exactly permanent or foolproof. Should you ever have to reformat your hard disk or boot from a floppy disk, the TSR will be ignored and your machine will fail to recognize the rollover. Alternatively, for a permanent fix, you can install an ISA card that acts as an extension to your BIOS. Several are currently available, including the **AMI Year 2000 BIOS Enabler Card** (\$59.95 list) from American Megatrends (800-828-9264, www.megaraid.com), the **MillenniumPro** (\$79.95 list) from a division of Award known as Unicore Software (800-800-2467, www.unicore.com), and the **MFI Flash 2000** (\$34.95 list) from Micro Firmware (800-767-5465, www.firmware.com). These products are relatively expensive (despite price decreases if you buy in bulk), but they can indeed ensure compliance.

OUR RECOMMENDATION

If you're dealing with a single machine, we recommend that you implement your own fix (unless you have the Award problem, which requires another solution). It will

Correcting the Year 2000 Problem (for Most Machines)

VIA A DOS BOOT DISK:

1. Wait for the year 2000 to arrive.
2. Insert a boot disk into your floppy disk drive and power up your system.
3. Type "date". If the year reads 1980, change it to 2000.
4. Reboot from the floppy disk. The year should read 2000.

VIA BIOS SETUP:

1. Wait for the year 2000 to arrive.
2. Enter the BIOS setup at boot-up (see your PC's documentation).
3. If the year reads 1980, change it to 2000.
4. Reboot and reenter the BIOS setup. The year should read 2000.

VIA WINDOWS 95 (NOT RECOMMENDED)

1. Wait for the year 2000 to arrive.
2. Boot to Windows and access the Date/Time icon under the Control Panel.
3. If the year reads 1980, change it to 2000.
4. Reboot and return to Date/Time. The year should read 2000.

cost you nothing but a few minutes on the morning of January 1, 2000, or any day thereafter. The best solution, of course, is to obtain a BIOS upgrade. If you've got hundreds of machines to fix, then you may want to weigh the cost of ISA cards against the relative instability of a TSR.



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You don't get to recharge your batteries every four hours. You don't get to rest whenever you feel like it. Why should your notebook? Life on the road is no cakewalk and your notebook should be designed to endure the rigors of mobile life as well as you do. Introducing the GoBook notebook. With a revolutionary modular battery design, lightning-fast performance featuring the fastest Intel® Pentium® II processors, and an incredibly thin and light package, it's the ultimate companion for those who stop at nothing to succeed. It's no wonder that CNET just awarded the GoBook Editors' Choice for best UltraPortable on the market, saying, "Micron's GoBook lessens the angst of life on the road."

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is a lot for water. Solitaire is actually pretty fun for about a minute. That person looks like somebody I know. I'm actually excited about the prospect of getting on a plane. Why isn't my cell phone working? That kid keeps staring at my GoBook. This is better than being in the office, I guess. What's that smell?



YOUR ONLY FRIEND DURING A THREE-HOUR LAYOVER



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"The GoBook outperformed every other machine in our review by a sizeable margin" *CNET, Editors' Choice, Best UltraPortable Reviewed, May '98*



Here's the GoBook difference: Featuring the fastest Intel Pentium II processors • Preloaded with Microsoft's Windows 98 • Includes a big active matrix 12.1" SVGA display powered by 128-bit graphics accelerator • A revolutionary modular battery design that performs as well traveling across town as it does across the Atlantic Ocean • Big room for expandability: The GoBook includes both a 24X CD-ROM drive and a 3.5" floppy drive • All in a super thin and light package that starts at just 1.35" thin and 4.4lbs.*



GoBook™ 266



GoBook² 233



**New!
GoBook² 300**

Model Name	GoBook™ 266	GoBook ² 233	GoBook ² 300
Processor	Intel® Pentium® processor with MMX™ technology 266MHz	Intel Pentium II processor 233MHz	Intel Pentium II processor 300MHz
RAM	32MB EDO RAM	64MB EDO RAM	64MB EDO RAM
Hard Drive	3.2GB hard drive	3.2GB hard drive	3.2GB hard drive
Monitor	12.1" SVGA display	12.1" SVGA display	12.1" SVGA display
CD-ROM	24X modular CD-ROM drive	24X modular CD-ROM drive	24X modular CD-ROM drive
Graphics	PCI bus with 128-bit graphics accelerator	PCI bus with 128-bit graphics accelerator	PCI bus with 128-bit graphics accelerator
Sound System	16-bit stereo/Wavetable sound	16-bit stereo/Wavetable sound	16-bit stereo/Wavetable sound
Cache	512KB L2 pipeline burst cache	512KB L2 pipeline burst cache	512KB L2 pipeline burst cache
Warranty	5-year/1-year Micron limited warranty	5-year/1-year Micron limited warranty	5-year/1-year Micron limited warranty
Software Included	Norton AntiVirus System Wizard Mobile Client™™ Microsoft® Windows® 98	Norton AntiVirus System Wizard Mobile Client™™ Microsoft Windows 98 Microsoft Office Small Business Edition	Norton AntiVirus System Wizard Mobile Client™™ Microsoft Windows 98 Microsoft Office Small Business Edition
Also Includes:	Bay battery 4.4lbs (w/floppy drive)* 6.7lbs (w/opt./base battery & floppy) USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports MPEG compatible CardBus/Zoomed Video ready Microphone, stereo line-in/out jacks 2 Type II or 1 Type III PCMCIA slots 2-way infrared port Touchpad pointing device Modular floppy drive Add SuperBase battery for \$299	Bay battery 4.4lbs (w/floppy drive)* 6.7lbs (w/opt./base battery & floppy) USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports MPEG compatible CardBus/Zoomed Video ready Microphone, stereo line-in/out jacks 2 Type II or 1 Type III PCMCIA slots 2-way infrared port Touchpad pointing device Modular floppy drive Add SuperBase battery for \$299	Bay battery 4.4lbs (w/floppy drive)* 6.7lbs (w/opt./base battery & floppy) USB, parallel, serial, VGA, PS/2, NTSC/S-Video ports MPEG compatible CardBus/Zoomed Video ready Microphone, stereo line-in/out jacks 2 Type II/1 Type III PCMCIA slots 2-way infrared port Touchpad pointing device Modular floppy drive Add SuperBase battery for \$299

Price

\$2399 \$84/mo.
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Lease, 36 mos.**

\$2599 \$91/mo.
TechRefresh Bus,
Lease, 36 mos.**

\$3099 \$108/mo.
TechRefresh Bus,
Lease, 36 mos.**



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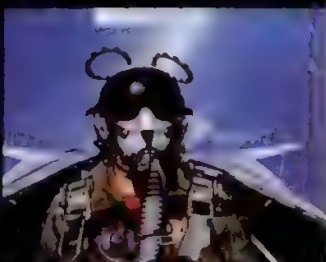
1 Clocked at speeds over 500MHz, the Millennia is the fastest land animal. This "big cat" hunts mainly gazelles, but the average chase lasts only about 20 seconds.

2 In early September 1998, PC World Magazine ranks the Micron Millennia the #1 Power Desktop on the market calling it "the fastest of all" systems tested.

INTRODUCING THE FULLY LOADED MICRON 450MHz MILLENNIA

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Micron Systems:
Over 100,000 deployed Micron desktops, notebooks & servers

Favorite Feature:
Price/power ratio

Purpose:
Help maintain US security and freedom

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Tim Willits
Lead Map Designer, Id Software
Creators of Quake & Quake II



Micron Systems:
Micron Millennia 400 desktops

Favorite Feature:
400MHz - Of course

Purpose:
Test mind-bending levels of Quake II and help create one of the coolest games ever

For The Whole Story:
www.micronpc.com



Featuring Intel's Fastest Processor Ever

Just named #1 Power Desktop by the editors of PC World Magazine (Millennia 400 DVD - September '98)
Micron's Millennia desktop product line continues a long tradition of industry-leading, award-winning performance. Perhaps that's why some of the most prominent power users around rely on Micron. No matter how strenuous your demands, no matter how colossal the task, we invite you to put a Millennia desktop to the test. You'll be hard-pressed to find a Pentium II processor based system as powerful and affordable as the Micron Millennia. And Micron's revolutionary new MPower™ purchase program makes Millennia ownership even easier, offering qualified users no interest* or payments for six months as well as PowerXchange™ trade-in options on your current PC towards a new Millennia desktop.



**MICRON
RANKED #1
DESKTOP
CUSTOMER
SATISFACTION**

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3 The fastest typist in the world types 176 words per minute. To give you some idea of how many words that is, this little blurb is only 30 words long.

4 The newest Micron 100mmia features the Intel Pentium II processor 450MHz, the fastest chip available. Don't settle for anything less.

THERE IS NO KNOWLEDGE THAT IS NOT POWER.

— RALPH WALDO EMERSON

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98 10

How important is a 15% performance difference? Think of it as 1 hour and 12 minutes in an 8-hour day.

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The Micron Difference: Rock-Solid Reliability. MPower™ and PowerXchange™ Programs. Industry-Leading Service and Support.

There's a lot more to owning a system than having a computer sitting on your desk. You'll always want the latest technology, the best pricing and service and

support you can count on — and that's exactly what Micron's new MPower program is all about. Call today for details or visit www.micronpc.com/pcmag.



Model Name **Millennia C300** **Millennia 350** **Millennia 400** **New! Millennia 450** **New! Millennia 450 MAX**

Processor	Intel® Celeron™ processor 300MHz	Intel Pentium® II processor 350MHz	Intel Pentium II processor 400MHz	Intel Pentium II processor 450MHz	Intel Pentium II processor 450MHz
RAM	32MB SDRAM	64MB 100MHz SDRAM	64MB 100MHz SDRAM	64MB 100MHz SDRAM	128MB 100MHz SDRAM
Hard Drive	4.3GB Ultra ATA hard drive	8.4GB Ultra ATA hard drive	10GB Ultra ATA hard drive	10GB Ultra ATA hard drive	14.4GB 7200 RPM Ultra ATA hard drive
Monitor	15" Micron 9000x monitor (13.8" display)	17" Micron 7000x monitor (15.9" display)	17" Micron 7000x monitor (15.9" display)	17" Micron 7000x monitor (15.9" display)	19" Micron 900Lx monitor (18" display)
DVD/CD-ROM	32X max speed CD-ROM drive	32X max speed CD-ROM drive	32X max speed CD-ROM drive	32X max speed CD-ROM drive	DVD-ROM drive and decoder card***
Graphics	nVidia Riva 128, 4MB SGRAM 3D ACP graphics	nVidia Riva 128, 4MB SGRAM 3D ACP graphics	nVidia Riva 128, 4MB SGRAM 3D ACP graphics	nVidia Riva 128, 4MB SGRAM 3D ACP graphics	Radi 3D Starfighter 1740, 8MB ACP graphics
Sound System	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	PCI 64-voice Wavetable sound	64-voice Wavetable 3D stereo sound
Cache	128KB internal cache	512KB internal cache	512KB internal cache	512KB internal cache	512KB internal cache
Warranty	5-year/3-year Micron Power™ limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty	5-year/3-year Micron Power limited warranty

Software Included	Microsoft® Windows® 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition	Microsoft Windows 98 Microsoft Office 97 Small Business Edition
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Also Includes:	New MicroTower™ case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse® 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse® 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse® 3.5" floppy drive	New MicroTower case Advent AV009 stereo speakers 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse® 3.5" floppy drive	Micron MiniTower case Advent AI390PL-70 w/2 3-piece sound system Advent subwoofer 3Com/U.S. Robotics 56K WinModem** 104-key enhanced keyboard Microsoft IntelliMouse 3.5" floppy drive
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Price	\$1199 ^{'42/mo.} TechRefresh Bus. Lease, 36 mos.**	\$1649 ^{'58/mo.} TechRefresh Bus. Lease, 36 mos.**	\$1849 ^{'65/mo.} TechRefresh Bus. Lease, 36 mos.**	\$1899 ^{'66/mo.} TechRefresh Bus. Lease, 36 mos.**	\$3099 ^{'108/mo.} TechRefresh Bus. Lease, 36 mos.**
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Upgrade to:	6.4GB Ultra ATA hard drive 17" Micron 7000x monitor (15.9" display) 100MB Iomega Zip drive	10GB Ultra ATA hard drive 100MB Iomega Zip drive Microsoft Natural Keyboard Elite	19" Micron 900Lx (18" display) 100MB Iomega Zip drive Advent subwoofer	19" Micron 900Lx (18" display) 100MB Iomega Zip drive Advent subwoofer	100MB Iomega Zip drive 256MB 100MHz SDRAM
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Price	\$1497 ^{'53/mo.} TechRefresh Bus. Lease, 36 mos.**	\$1833 ^{'64/mo.} TechRefresh Bus. Lease, 36 mos.**	\$2232 ^{'78/mo.} TechRefresh Bus. Lease, 36 mos.**	\$2282 ^{'80/mo.} TechRefresh Bus. Lease, 36 mos.**	\$3488 ^{'121/mo.} TechRefresh Bus. Lease, 36 mos.**
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MICRON'S CLIENTPRO ALLOWS YOU TO HARNESS THE POWER OF WINDOWS NT.

CRITICS RAVE ABOUT THE MICRON CLIENTPRO

"The Micron ClientPro 486 provides a powerful and reliable solution for business environments." — PC Magazine, January 30, 1998

NetFRAME

THEY SHOULD CALL ME HERO.

Since 1985 Micron's line of NetFRAME servers has been providing rock-solid, tireless service, becoming one of the most highly recommended brands on the server market today.



If you're looking for the ultimate complete network solution, or simply need to upgrade your current network, consider Micron™ ClientPro® managed PCs and Micron NetFRAME® servers. Network-ready right out of the box, packing the power of the Intel® Pentium® processor 450MHz, and built on industry standards, the ClientPro effortlessly puts more manageable power in your office. And if you're looking for a reliable and expandable server, it would be tough to beat Micron's NetFRAME

"MICRON'S DUAL-PROCESSOR... SERVER RUNS FULL SPEED AHEAD."

— PC Computing A-List Editors' Choice



servers running with a powerful new Intel Pentium II Xeon™ processor. Since 1985 Micron's line of NetFRAME servers has been providing rock-solid, tireless service, becoming one of the most highly recommended brands on the server market today. Combining advanced technology, superlative engineering and industry-leading service and support, Micron's award-winning line of NetFRAME servers continue to push the price/performance envelope and exceed user expectation.

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OBsolescence PROTECTION

3. Other computer companies make you wait 2 to 4 years in their upgrade programs before you can build up, and many hold you to restrictive finance agreements. With Micron you're eligible to upgrade a system anytime from 12 to 48 months after purchase, regardless of how you finance your purchase. Plus, you can send in your old machines for wholesale trade-in rebates which apply towards the purchase of new machines.

CUSTOM CONFIGURATION

4. Some manufacturers force you to purchase pre-selected software packages to qualify for their programs. Not Micron. We offer unparalleled hardware and software flexibility with all our custom-configured machines.

New Rules. New Tools.



ClientPro CE 300



ClientPro CS 450



NetFRAME 3100

Small Business Server Edition



NetFRAME 6200

Intel® Celeron™ processor 300MHz
64MB SDRAM
3.2GB Ultra ATA hard drive
17" Micron 700Vx (15.9" display)
32X max speed CD-ROM drive
Integrated nVidia Riva 128, 4MB SGRAM 3D AGP graphics
64-voice PCI WaveTable sound
128KB internal L2 secondary cache
3Com 3C905 WOL 10/100 network card
5-year/3-year Micron Power™ limited warranty

Intel LANDesk® Client Manager available
Microsoft® Windows NT® Workstation 4.0®
Morton AntiVirus

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Chassis intrusion detection
Fan, temperature, and voltage problem reporting
Virus detection reporting
Remote Wake Up™ capability
New MicroTower case
3.5" floppy drive
104-key enhanced keyboard
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TechRefresh Bus.
Lease, 36 mos.¹

Intel Pentium II processor 450MHz
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17" Micron 700Vx (15.9" display)
32X max speed CD-ROM drive
Diamond Viper 330 nVidia, 4MB AGP video
64-voice PCI WaveTable sound
512KB internal L2 secondary cache
3Com 3C905 WOL 10/100 network card
5-year/3-year Micron Power™ limited warranty

Intel LANDesk Client Manager available
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SMART II hard drive monitoring
Chassis intrusion detection
Fan, temperature, and voltage problem reporting
Virus detection reporting
Remote Wake Up™ capability
MiniTower case
3.5" floppy drive
104-key enhanced keyboard
Microsoft IntelliMouse

\$2499 \$87/mo.
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Intel Pentium II processor 350MHz
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4GB Ultra Wide SCSI-3 hard drive
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Microsoft BackOffice Small Business Server 4.0
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Intel 440BX chip set
100MHz front side bus
Integrated Symbios PCI Ultra Wide SCSI-3
Intel EtherExpress Pro 100 network adapter
dual channel controller
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8 drive bays: 1 external 3.5", 2 external 5.25"
5 hot-swap 1.0" hard drive bays
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Microsoft mouse, 104-key enhanced
PS/2 keyboard
3.5" floppy drive

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Intel Pentium II Xeon™ processor 400MHz
Options for 512KB or 1MB L2 cache Xeon processor
128MB ECC 100MHz SDRAM
9GB UZW LVDS SCA 1" hard drive
32X SCSI CD-ROM drive
5-year/3-year Micron Power limited warranty
Dedicated Server Technical Support, 7x24
1-year next-business-day on-site service
Intel LANDesk Server Manager 3.0
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Supports up to four Intel Pentium II Xeon processors
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Memory: ECC EDO up to 4GB (via 16 DIMM sockets)
7 expansion slots: 6 PCI, 1 shared ISA/PCI
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1 integrated Symbios narrow SCSI controller
Ethernet card
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1 hot-swappable 400-watt power supply
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3 external 5.25" media bays
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(rack mount option available)
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Microsoft mouse
1 parallel, 2 serial ports
1-year next-business-day on-site service***
Dedicated server technical support 7x24

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TechRefresh Bus.
Lease, 36 mos.¹

NETFRAME SERVERS RUNNING WINDOWS NT GIVE YOU THE POWER TO GET AHEAD.

Micron was also the first PC company to ship Microsoft Windows NT over four years ago and is one of the leaders in the current shift to the Windows NT platform. So when you're ready to put the power of Windows NT management into your office network, look to the experience and affordability of Micron ClientPro managed PC and Micron NetFRAME servers. Call today for more information or to order direct from the factory or visit www.micronpc.com/cshop.



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TOOLS FOR TESTING OFF-THE-SHELF APPS

By Greg Alwang

So you've got a plan for snuffing out those huge Y2K wildfires in your mainframe and enterprise-level systems. What do you do when dozens or hundreds or thousands of tiny Y2K blazes crop up in your widely dispersed PC desktop applications? Worse yet, what if these desktop blazes infiltrate your larger systems and jeopardize your Y2K compliance?

If you didn't anticipate addressing Y2K problems on your desktop PCs, you could be in for a heated battle. Fortunately, it's not too late to get started, and there are loads of tools to help you find those noncompliant applications and data files so you can reduce your chances of getting burned come January 1 or January 3, 2000.

ly so if this data is shared with larger systems or outside sources.

Problems range from miscalculations and incorrectly stored dates to applications halted by invalid dates. Even worse, you may have date-related problems that go unnoticed until it's too late. Envision cancellation notices being sent to active customers or disbursement checks being issued with bogus amounts.

ONMARK 2000's intuitive interface, with its VCR-like controls, lets you easily fine-tune, start, and stop your database or spreadsheet scans.

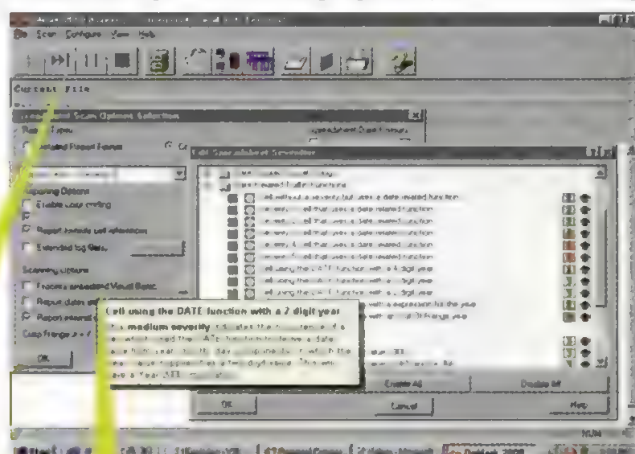
PLANNING FOR THE ATTACK

Just as with larger systems, you must formalize a plan to deal with issues on the desktop. The same basic steps apply: Discover and assess the Y2K risks, prioritize based on criticality, remedy the Y2K problems, and test the results. To identify the risks in your off-the-shelf applications, custom

software, and data files, you must consider several factors, including:

- vendor compliance statements (we list some for four major

out the others could be a mistake. For example, even though a vendor says an application is Y2K compliant, there's still the chance that noncompliant data can be introduced through data entry, formulas, or custom programs (see "What's the Big



YOU CAN CUSTOMIZE OnMark's five severity levels to eliminate excess information and false-positives from your reports. You'll spend your time more effectively on real problems.

Deal?" earlier in this article).

Separating the real risks from the nonissues and minimizing the fallout require assembling a

Y2K team that can work closely with PC-based data decision makers and end users during risk assessment. One responsibility of the Y2K team is to uncover the different ways date-related problems can arise based on how applications and data are used.

This information is critical to fine-tuning your prioritization and remediation steps. Don't hinder your chances of making

your critical systems compliant in time, because your Y2K team is busy testing data and programs that pose no real Y2K threat.

Start your Y2K compliance testing early, prioritize effectively, test thoroughly, and automate wherever possible.

TOOLS THAT HELP

Fortunately, many tools are cropping up for analyzing, prioritizing, fixing, managing, and reporting on the risks of Y2K date problems in popular applications and data files. We'll survey some of those tools here.

For starters, we found the features of even this handful of products to be all over the map: Some only help you find problems, whereas others assist with

Express 2000 Reports - [Application Compliance by Machine]

Warning: This software provides your 2000 results which are based on information from vendors. It is your responsibility to independently confirm the year 2000 information with the applicable vendor(s). WHO IS NOT LIABLE FOR ANY DAMAGES WHICH MAY RESULT FROM USING THESE REPORTS. See our license conditions for more details.

Manufacturer	Application	Version	Y2K Compliance
Microsoft	Microsoft Access	9.0	Compliant
Apple Computer, Inc.	QuickTime for Windows	2.1	No application info
Dell Computer Corporation	Dell System Tools	1.0	No application info
Microsoft	Microsoft Backup	3.14	No application info
Microsoft	Microsoft Outlook	5.0	Compliance issues
Microsoft	Microsoft Outlook Express	2.0	No application info
Microsoft	Microsoft FrontPage	97 SR-1	Compliant
Microsoft	Microsoft Exchange	4.0	Compliance issues
Microsoft	Microsoft FrontPage	98	Compliant
Microsoft	Microsoft FrontPage Express	2.02	No application info
Microsoft	Microsoft Internet Explorer	2.10	Compliant
Microsoft	Microsoft Internet Explorer	4.0	Compliant
Microsoft	Microsoft Internet Explorer	2.0	No application info
Microsoft	Microsoft Internet Explorer	98	Compliant
Microsoft	Microsoft Internet Explorer	4.72	No application info
Microsoft	Microsoft Internet Explorer	97	Compliant

REPORTS CAN BE broken down by machine, providing an excellent way to assess the total applications compliance status for each PC you need to check.

Many businesses downplay the effect PC-based applications and data will have on the whole

Y2K picture. The fact is, depending on the volume of applications and data stored on the desktops in your business, you could face serious problems if some fail to be Y2K-compliant. This is especial-

ly so if this data is shared with larger systems or outside sources.

- how custom programs were designed;
- how applications and data integrate with other systems.

Considering one of these factors with-

"Location, location, location. With all our different offices, we need a choice of color printers."

TRISH SZEGO
BROKER
ERA, ELITE GROUP
REALTORS

LOS ANGELES

Paris
Chicago

Lexington
LONDON
BOSTON



Optra Color 40



Optra Color 45



Optra
SC 1275



Optra Color 1200

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COLORFUL PEOPLE FOR LEXMARK

Year 2000 Compliance—As Software Vendors See It

Here are statements from four vendors about the Y2K readiness of some popular applications, plus general statements about what year 2000 compliance means—all in the vendors' own words. Check out their individual Web sites for the latest information.

COREL 800-772-6735, www.corel.com

Product	Year 2000 compliant?	Explanation from company
COREL PARADOX		
Paradox—earlier versions	Not tested for year 2000	You need to contact the original developer, Inprise, (formerly Borland International Inc.) for Year 2000 information. Inprise's website address is http://www.inprise.com/devsupport/y2000
Paradox 7	Tested with no issues	We have tested this product as a component of Corel WordPerfect Suite 7 for Windows 3.X. However, this product was developed by Borland International Inc. If you own a standalone version of this product, you should contact Inprise (formerly Borland) for Year 2000 information. Inprise's website address is http://www.inprise.com/devsupport/y2000
Paradox 8	Tested with no issues	We have found no Corel application-specific year 2000 date related issues to date. Upper date limit for 4 digit entry is 9999+
COREL QUATTRO PRO		
Quattro Pro—earlier versions	Not tested for year 2000	: Will not be tested
Quattro Pro 6	: Tested with documented issues	: Issues and workarounds are available at http://205.227.112.10/alliacdocs/16800.htm
Quattro Pro 7	Tested with no issues	We have found no Corel application-specific Year 2000 date related issues to date. Upper date limit for 4-digit entry is 3199+
Quattro Pro 8	Tested with no issues	We have found no Corel application-specific Year 2000 date related issues to date. Upper date limit for 4-digit entry is 3199+

COREL SAYS: Since there is no agreed-upon definition of what "Year 2000 compliant" means, we recommend that users look carefully at how terms like "Year 2000 compliant" or "Year 2000 ready" are used by each software and hardware vendor. Corel refers to its "Year 2000 Tested" products as "tested" rather than "compliant" to help avoid confusion about what "compliant" means for a given product, or to a given user. We tell our customers where a product has been tested for Year 2000 issues, and whether we have found Corel application-specific Year 2000 issues with the product. Three

main areas of Year 2000 issues are important when a product is tested for Year 2000 issues. The product must function under operation systems dates into the 21st century. The product must properly handle dates from both the 20th and 21st century across the product's designated operational range. The product must recognize Feb. 29, 2000 as a valid leap year day. Corel has made every effort to ensure that its product testing is accurate. However, because each user's environment is different from our testing environment, it is always the user's responsibility to assess and evaluate the Year 2000

readiness of the Corel products within their own environment. Therefore, all information provided by Corel is provided for information purposes only as a courtesy to our customers and should in no way be considered to be an extension of any rights, remedies, warranties or other obligations found in the end user license agreement accompanying Corel software. Please refer to the license agreement that accompanies each Corel software product to determine all obligations, rights and remedies of Corel and users of Corel software products. <http://www.corel.com/2000.htm>

LOTUS 800-343-5414, www.lotus.com

Product	Year 2000 compliant?	Explanation from company
LOTUS 1-2-3		
1-2-3 1.x for DOS	: Ready*	Entering two digit years into a cell assumes that the year is in the 20th century. User must enter a three digit year between 00 and 199 for the years 1900–2099
1-2-3 2.x, 3.x, and 4.x for DOS	: Ready	Same as above
1-2-3 1.x for Windows 3.1	: Ready	Same as above
1-2-3 4.x and 5.0 for Windows 3.1	: Ready*	Same as above
1-2-3 5.01	: Ready*	Same as above
1-2-3 97	: Ready	Will interpret two digit year dates either as the 19xx or 20xx based on which year you enter (thinks 00–49 indicates the 21st century and 50–99 indicates the 20th century). This behavior can be overridden by setting preferences in the User Preferences dialog
1-2-3 Millennium Edition (R9)	Ready	Will interpret two digit year dates using a sliding window with an 80/20 user definable window. Dates 20 years greater than the current year will be assumed in the current or future century
LOTUS APPROACH		
Approach 2.0	Ready	Enter four digit year
Approach 3.0	: Ready	All date fields accept four digit years for dates. A fixed window based on 29 is used for two digit year interpretation. Two digit years between 00–29 will be assumed to be 20xx. Years from 30–99 will be 19xx
Approach 96 and 97	: Ready	Same as above
Approach Millennium Edition (R9)	: Ready	Will interpret two digit year dates using a sliding window with an 80/20 user definable window. Dates 20 years greater than the current year will be assumed in the current or future century

LOTUS SAYS: A product is Year 2000 ready if the product, when used in accordance with its associated documentation, is capable of correctly processing, providing and/or receiving date data within and between the 20th and 21st centuries, provided that all products (for example, software hardware and firmware) used with the product properly exchange accurate date data with it. Although the term "Year 2000 compliant" is occasionally used in the IT industry and by our customers, the phrase implies some sort of standard, something that today does not exist. There is no universally accepted definition of "Year 2000 compliance." When IBM and Lotus use "Year 2000 ready," we mean that a product will be able to function correctly within and between the 20th and 21st centuries, provided that all other computer products used with it exchange accurate date information. Lotus recognizes that customers need information regarding the continuing

availability of support for Year 2000 ready products as they develop and implement plans to ready their systems. To assist customers in this regard, Lotus has extended the availability of support for date related issues until at least January 31, 2001 for those Year 2000 ready Lotus software products on which support is currently offered. Exceptions to this policy include those products for which end of support dates prior to the year 2001 were previously announced. A list of exception products is maintained on the web as part of the IBM Year 2000 Product Readiness Database accessible from both the Lotus and IBM Year 2000 Home Pages. Lotus Year 2000 readiness information is current as of the date communicated, is provided for informational purposes only, and is furnished "as is" without warranty of any kind, express or implied. This information is not, and should not be construed to be, warranty or any extension or modification to the terms of any

applicable warranty. The limited warranty for Lotus products is solely as contained in the software agreement governing use of Lotus software. Information regarding the Year 2000 readiness status of Lotus software applies to Lotus products only. It does not apply to any "as is" or non-Lotus software that may be provided with a Lotus software product. Lotus' assessment of the Year 2000 readiness of its products is an ongoing effort, and the information contained herein is subject to change. <http://www.lotus.com/year2000>
Ready—The product has been tested and meets the Lotus and IBM definition of year 2000 readiness when used as packaged and sold Ready*—Indicates a minor issue for which a customer action is required to be Ready. May include application of a required maintenance release, update, fix, or documented workaround

Continues



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Professional-quality synthesizers and digital I/O provide audio fidelity that rivals movie theaters with digital sound.

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With the EMU10K1 audio processor, every signal is processed at 32-bit, 192dB, 48kHz using 8-point interpolation to smooth the sound - instantly improving any audio source.

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Experience depth and realism beyond existing 3D audio. Apply preset environments such as hall, cave or underwater to your existing games and applications for incredibly true sound.

Multiple Speaker Output

Produce surround-sound audio on your PC with built-in support for two or four analog speakers.

Digital I/O Card

This hardware feature provides digital S/PDIF I/O and a breakout of the MIDI I/O through MIDI DIN connectors. A Digital DIN connector is provided for further connection of up to eight digital speakers.

256-Voice Music Synthesis

Remarkable 256-voice capability goes beyond the quality and performance available in most professional music equipment.

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Be assured of near-perfect Sound Blaster compatibility while enjoying the benefits of the PCI bus.

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An open standard that allows the broadest support from software developers.

Sound Blaster Live! Website - www.sblive.com

Visit the Website for instant access to the latest applications, enhancements and drivers.

Rich Software Bundle

An amazing array of software to enrich your experience with Sound Blaster Live!

CREATIVE

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What is Environmental Audio™?

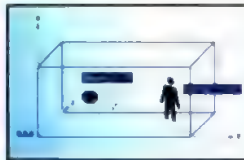
Environmental Audio — the next audio platform by Creative. Its revolutionary technology recreates real-world multi-dimensional audio on your PC. It immerses you in sound so vivid, you experience games, music, and other existing audio applications rather than just hear them.



Environmental Audio™
by CREATIVE®

By nature, the human ear is intolerant of audio imperfections. The Environmental Audio Platform addresses this problem by introducing a system comprised of the following components:

- **Environmental Audio Hardware** powered by the powerful 1,000+MIPS, 2 million transistor EMU10K1™ audio processor chip, Sound Blaster Live! provides the highest possible audio fidelity with multiple digital audio input/output (I/O) capabilities.
- **Environmental Audio Software Technologies** created by E-mu Systems®, Inc., a subsidiary of Creative, that provides high-end audio equipment to Hollywood studios, will change the way you perceive audio forever. They include:
 - **E-mu Environmental Modeling™**, which accurately positions audio objects in a 3D space by rendering audio reflections and;
 - **Creative Multi Speaker Surround™**, which allows real-time panning and mixing of multiple sound sources using two or more speakers. These technologies will greatly enhance audio content from the past, the present, and the future.
- **Environmental Audio Extensions (EAX)** enable game and application developers to easily enhance their software with high-quality Environmental Audio effects. EAX is designed to be a natural extension to Microsoft® DirectSound® 3D API and has received overwhelming support from hundreds of software developers.
- **Environmental Audio Speaker Systems** work well with two-speakers, but Environmental Audio will deliver its full potential with Creative's new line of multi-channel systems.



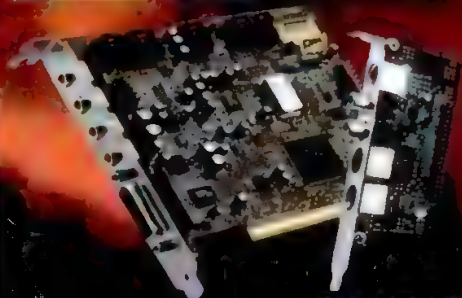
The **PCWorks™ FourPointSurround™** speaker system is the best companion for your Sound Blaster Live!. It offers four compact satellite speakers and a powered subwoofer.

The **Desktop Theater™ 5.1**, a great companion for your PC-DVD™ system, is a five-satellite plus powered subwoofer speaker system with an amplifier and a built-in Dolby® Digital decoder.



Look for the **Environmental Audio logo** on selected Creative and Cambridge SoundsWorks® products, and new supported game titles to ensure you are getting the Live! experience.

Sound Blaster® Live! Card



Digital I/O Card

Technical Specifications

Wave-Table Synthesis

- E-mu® Systems EMU10K1™ music synthesis engine
- 64-voice polyphony with E-mu's patented 8-point interpolation technology
- 192-voice polyphony PCI wave-table synthesis
- 48 MIDI channels with 128 GM & GS-compatible instruments and 10 drum kits
- Uses SoundFont® technology for user-definable wave-table sample sets; includes 2MB, 4MB, and 8MB sets
- Load up to 32MB of samples into host memory for professional music reproduction

Effects Engine

- E-mu Systems EMU10K1 patented effects processor
- Supports real-time digital effects like reverb, chorus, flange, pitch shifter, or distortion across any audio source
- Capable of processing, mixing, and positioning audio streams using up to 131 available hardware channels
- Customizable effects architecture allows audio effects and channel control
- Full digital mixer maintains all sound mixing in the digital domain, eliminating noise from the signal
- Full bass, treble, and effects controls available for all audio sources

3D Audio Technology

- User-selectable settings are optimized for headphones and two or four speakers
- Accelerates Microsoft® DirectSound® and DirectSound 3D
- Support for Environmental Audio™ property set extensions
- Creative Multi Speaker Surround™ technology places any mono or stereo sound source in a 360° audio space
- Creative Environments—user-selectable DSP modes that simulate acoustic environments like Hall, Theater, Club, etc. on any sound source

Hollywood-Quality, 32-Bit Digital Audio Engine

- User-selectable bit rates from 8- to 16-bit
- User-selectable sample rates from 8kHz to 48kHz
- All sound sources are handled with 32-bit precision for highest quality output
- Analog and Digital I/O modes supported
- Hardware full-duplex support enables simultaneous record and playback at 8 standard sample rates
- UGDAES AC97 audio codec

MIDI Interface/Joystick Port

- Supports MPU-401 UART mode
- IBM® compatible 15-pin joystick port with analog support
- Support for digital and DirectInput™ game devices

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98

Year 2000 Compliance—As Software Vendors See It (continued)

MICROSOFT 800-426-9400, www.microsoft.com

Product	Year 2000 compliant?	Explanation from company
MICROSOFT ACCESS		
Access, Version 2	No	User must enter all 4-digits of the year to interpret the date as being in the 21st century. Problem may be avoided by consistently enforcing a long date format (4-digit years) for entry and display. An upgrade to Microsoft Access 95 v 7.0 or Microsoft Access 97 v 8.0 is recommended for those for whom the above solution is not sufficient.
Access 95, Version 7	Yes—up to 2035 or later	Must have OLEAUT 32 DLL version 2 20 4049 or higher. Dates can be input in pre-defined and custom input formats, via an Input Mask. Input Masks enforce date entry in a particular format.
Access 97, Version 8	Yes—up to 2035 or later	No prerequisites. Dates can be input in pre-defined and custom input formats, via an Input Mask. Input Masks enforce date entry in a particular format.

MICROSOFT EXCEL

Excel, Versions 5 to 8	: Yes—up to 2035 or later	No prerequisites. Recognizes 01-JAN-1900 through 31-DEC-2078 as valid dates. A two digit year less than 20 is assigned to the 21st century. A two digit year greater than or equal to 20 is assigned to the 20th century.
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MICROSOFT MONEY

Money 1.0 and 2.0	: Yes—up to 2075	Accepts dates from 1/1/1948 through 12/31/2075
Money 3.0 to 5.0	: Yes—up to 2075	Accepts dates from 1/1/1948 through 12/31/2075 generally, and 1/1/1993–12/31/2075 for certain online banking services.
Money 6.0 (Money 98)	: Yes—up to 2200 generally, up to 2092 for some online banking	Accepts dates from 1/1/1900 through 12/31/2200 generally, and 1/1/1993–12/31/2092 for certain online banking services

MICROSOFT SAYS: A Year 2000 Compliant product from Microsoft will not produce errors processing date data in connection with the year change from December 31, 1999 to January 1, 2000 when used with accurate date data in accordance with its documentation and the recommendations and exceptions set forth in the Microsoft Year 2000 Product Guide, provided all other products (e.g., other software, firmware and hardware) used with it properly exchange date data with the Microsoft product. A Year 2000

Compliant product from Microsoft will recognize the Year 2000 as a leap year. **Disclaimer:** The Statement of Compliance refers to the Microsoft product as delivered by Microsoft. The Compliance Statement does not apply to user customizable features or third party add-on features or products, including items such as macros and custom programming and formatting features. The Microsoft Statement of Compliance does not constitute a warranty or extend the terms of any existing warranty. The

warranties provided for Microsoft's products, if any, are set forth in the end user license agreements (EULAs) that accompany the products or the terms of the license agreement under which you make use of a Microsoft product. The information available from Microsoft concerning the Year 2000 is provided for the sole purpose of assisting our customers in their planning for the transition to the Year 2000. <http://www.microsoft.com/year2000>

INTUIT 800-446-8848, www.intuit.com

Product	Year 2000 compliant?	Explanation from company
INTUIT QUICKEN		
Quicken for DOS Versions 1-4	No	Supports years through 1999
Quicken for DOS Versions 5-8	Untested	Intended to accept two-digit date format from 1901–2027. To enter a date from 2000–2027, the user is required to enter the four-digit year, or use an apostrophe as the year separator. For example: 12/31/03 = Dec. 31, 1903 or 12/31'03 = Dec. 31, 2003
Quicken for Windows Versions 1-4	Untested	Intended to accept a two digit date format from 1901–2027 throughout the product, except for online banking activities in version 5. To enter a date from 2000–2027, the user is required to enter the four-digit year, or use an apostrophe as the year separator. For example: 12/31/03=Dec. 31, 1903 or 12/31'03=Dec. 31, 2003
Quicken for Windows Version 5	: Yes, based on current testing, except for online banking	Intended to accept a two digit date format from 1901–2027 throughout the product, except for online banking activities in version 5. To enter a date from 2000–2027, the user is required to enter the four-digit year, or use an apostrophe as the year separator. For example: 12/31/03=Dec. 31, 1903 or 12/31'03=Dec. 31, 2003
Quicken for Windows Version 6	: Yes, based on current testing, except for online banking	Enhancements have been made to the date format intended to be accepted. If the customer types a two-digit year when entering a transaction date, 00–27 are interpreted as 2000–2027. The customer may still enter the years 1901–1927, but must either use a four-digit year or use an apostrophe as the year separator, which is the opposite of the method for previous versions of Quicken.
Quicken for Windows Versions 5 and 6—online banking	: No—see "Explanation from company" for Free Solution	Does not support dates later than December 31, 1999. Online banking customers may receive a year 2000 ready solution in one of three ways: 1.) some financial institutions will provide a free solution directly to such customers by 6/30/99, 2.) such customers may choose to purchase a new version of Quicken software in order to take advantage of its additional new features, or 3.) Intuit will provide a free solution directly to such customers by 6/30/99.
Quicken 98 for Windows	: Yes, based on current testing	Enhancements have been made to the date format intended to be accepted. If the customer types a two-digit year when entering a transaction date, 00–27 are interpreted as 2000–2027. The customer may still enter the years 1901–1927, but must either use a four-digit year or use an apostrophe as the year separator, which is the opposite of the method for previous versions of Quicken. Some releases of Quicken 98 require a free update to support dates later than December 31, 1999 for online banking transactional functionality. Intuit also is working with financial institutions as they test their systems and services for year 2000 readiness. Intuit intends to provide free solutions if changes are required to Quicken 98 as result of further Year 2000 readiness testing. Quicken 98 for Windows includes Microsoft Internet Explorer. In testing IE for Year 2000 readiness, Microsoft has found minor issues with some versions and has announced that it will make fixes available to consumers. For more information, obtain the version number of IE and consult www.microsoft.com/year2000
Quicken Financial Planner Versions 1-3	Yes, based on current testing	Intended to support date formats for years through 2999. Customers may enter years using two-digit and four-digit year formats. To enter dates past 2000 using a two-digit year, customers must use an apostrophe as the year separator. For dates past 2099, customers must use a four-digit year.
Quicken for Windows—future versions	: Yes (future)	Plans ultimately include removal of the upper date limit 2027. However, the company says the current implementation should not cause any significant practical problems since there is no current need to enter transactions that far in the future.

INTUIT SAYS: The information in this chart is derived from Intuit's Web site, www.intuit.com/support, which is accurate based on Intuit's current testing (which may in some cases be limited) done through July 31, 1998. Further testing may reveal that products listed are not compliant. Intuit is

developing a new and improved testing and classification standard so its products continue to meet the level of quality established by the company. Intuit has not yet determined which products it will test under the new standard. Compliance with the new standard may be determined

for a product only if and when such product is tested under the new standard. <http://www.intuit.com>

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an award
for working
16 hours a day,
seven days a week,
on a shoestring budget,
give me a call."**

DELL DIMENSION DESKTOPS

Common features: ♦ Mini-Tower Model ♦ 3.5" Floppy Disk Drive ♦ Two USB Ports ♦ Business Financial Manager 98, Direct Mail Manager and Expedite Streets 98) ♦ 1-Year On-site¹ Service ♦ Lifetime Toll-Free Hardware Phone Support

NEW DELL DIMENSION XPS R450 PENTIUM® II PROCESSOR AT 450MHz

- 128MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- 16.8GB Ultra ATA Hard Drive (9.5ms)
- 1600HS 21" (19.8" vis., .26dp, 1600 x 1200 max. res.) Trinitron® Monitor
- NEW ATI XPERT 98D 8MB 3D 2X AGP Graphics Card
- NEW DVD Multimedia Subsystem: 4.8X DVD-ROM Drive and Decoder Card
- Turtle Beach Montego A3D 64 Voice PCI Sound Card
- ACS-295 Speakers with Subwoofer
- 56K Capable² U.S.R. V.90 Modem
- ★ Omega Zip 100MB Internal Drive with Two Cartridges, add \$99.

\$3399

Business Lease³: \$125/Mo., 36 Mos.
Order Code #590901

NEW DELL DIMENSION XPS R450 PENTIUM II PROCESSOR AT 450MHz

- 128MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- NEW 13.6GB Ultra ATA Hard Drive (9ms)
- 1200HS 19" (17.9" vis., .26dp) Monitor
- NEW STB nVidia ZX 8MB 3D 2X AGP Graphics Card
- NEW 40X Max⁴ Variable CD-ROM Drive
- Turtle Beach Montego A3D 64 Voice PCI Sound Card
- NEW harman/kardon HK-195 Speakers
- ★ Upgrade to a 16.8GB Ultra ATA Hard Drive (9.5ms), add \$149.

\$2499

Business Lease³: \$95/Mo., 36 Mos.
Order Code #590902

Yoo-hoo...

DELL POWEREDGE SERVERS

Common features: ♦ 512KB Integrated L2 ECC Cache ♦ Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers ♦ 32X Max⁴ Variable SCSI CD-ROM Drive ♦ HP OpenView™ NNM Special Edition ♦ 3 External 5.25" Bays plus Floppy ♦ 4-1.6" or 6-1" Hard Drive Bays

DELL POWEREDGE 2300 SERVER NEW PENTIUM II PROCESSOR AT 450MHz

- (Dual Processor/RAID Capable)
- 128MB 100MHz ECC SDRAM
- 4GB Ultra-2/LVD SCSI Hard Drive
- Microsoft Windows NT Server 4.0
- APC Smart-UPS 700W Power Supply
- Intel Pro/100B PCI Ethernet Adapter
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 3-Year Next-Business-Day On-site¹ Service
- 7x24 Dedicated Server Hardware Technical Telephone Support

\$4699

Business Lease³: \$173/Mo., 36 Mos.
Order Code #250902

DELL POWEREDGE 2300 SERVER PENTIUM II PROCESSOR AT 350MHz

- (Dual Processor/RAID Capable)
- 64MB 100MHz ECC SDRAM
- 4GB Ultra-2/LVD SCSI Hard Drive
- Intel Pro/100B PCI Ethernet Adapter
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 3-Year Next-Business-Day On-site¹ Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
- ★ APC Smart-UPS 700W Power Supply, add \$369.

\$2649

Business Lease³: \$100/Mo., 36 Mos.
Order Code #250904



Reference the appropriate order code to receive featured configuration and pricing. Pricing not discountable. ♦ Prices and specifications valid in U.S. only and subject to change without notice. ¹For a complete copy of Guarantees or Limited Warranties, write Dell USA L.P., Attn: Warranties, One Dell Way, Round Rock, TX 78682. ²On-site service provided pursuant to service contract with third-party provider. May not be available in certain remote areas. Technician dispatched if necessary pursuant to phone-based troubleshooting. ³Business leasing arranged by Dell Financial Services L.P., an independent entity, to qualified customers. Above lease payments based on 36-month lease, and do not include taxes, freight, shipping charges, subject to credit approval, and availability. Above lease terms subject to change without notice. ⁴40X Max/17X Min. ⁵32X Max/14X Min. ⁶24X Max/10X Min. ⁷Download speeds limited to 56Kbps. Upload speeds are less (in the 30Kbps range) and vary by modem manufacturer. Speeds also vary depending on line conditions. Analog phone line and compatible server equipment required. Intel, the Intel Inside logo and Pentium are registered trademarks and Celeron is a trademark of Intel Corporation. MS, Microsoft, Intel Mouse, Windows and Windows NT are registered trademarks of Microsoft Corporation. 3Com is a registered trademark, and Fast Ethernet is a trademark of 3Com Corporation. Trinitron is a registered trademark of Sony Corporation. HP, DeskJet and LaserJet are registered trademarks and OpenView is a trademark of Hewlett-Packard Corporation. © 1998 Dell Computer Corporation. All rights reserved.

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Upgrades: • HP DeskJet 722C, add \$299 • HP LaserJet 6Lse, add \$399 • HP OfficeJet 600, add \$499

DELL DIMENSION XP6 R400 PENTIUM II PROCESSOR AT 400MHz

- 96MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- 10GB Ultra ATA Hard Drive (9ms)
- 1000LS 17" (15.9" vis) Monitor
- NEW ATI XPERT 98D 8MB 3D 2X AGP Graphics Card
- NEW 40X Max Variable CD-ROM Drive
- Crystal 3D 64V Wavetable Sound
- NEW harman/kardon HK-195 Speakers
- ★ Upgrade to 128MB 100MHz SDRAM, add \$60.
- ★ Upgrade to a 13.6GB Ultra ATA Hard Drive (9ms), add \$39.

\$1979

Business Lease : \$75/Mo., 36 Mos.
 Order Code #590903

NEW DELL DIMENSION V350 PENTIUM II PROCESSOR AT 360MHz

- 64MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- 6.4GB Ultra ATA Hard Drive (9ms)
- 1000LS 17" (15.9" vis) Monitor
- ATI 8MB 3D 2X AGP Graphics
- 32X Max Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- NEW harman/kardon HK-195 Speakers
- 56K Capable U.S.R. V.90 Data/Fax WinModem
- ★ Upgrade to 96MB 100MHz SDRAM, add \$89.
- ★ Upgrade to a 10GB Ultra ATA Hard Drive (9ms), add \$79.

\$1779

Business Lease : \$67/Mo., 36 Mos.
 Order Code #590906

NEW DELL DIMENSION V333c INTEL Celeron PROCESSOR AT 333MHz

- NETWORK DESIGNED DESKTOP:
- 32MB SDRAM
- 128KB Integrated L2 Cache
- 6.4GB Ultra ATA Hard Drive (9ms)
- 800F 15" (13.7" vis) Monitor
- ATI 8MB 3D 2X AGP Graphics
- 32X Max Variable CD-ROM Drive
- Integrated Intel 10/100 PCI Ethernet Controller
- ★ Upgrade to 64MB SDRAM, add \$69.
- ★ Upgrade to a 10GB Ultra ATA Hard Drive (9ms), add \$79.
- ★ Upgrade to a 1000LS 17" (15.9" vis) Monitor, add \$55.

\$1399

Business Lease : \$53/Mo., 36 Mos.
 Order Code #590904

DELL WORKSTATION

DELL PRECISION WORKSTATION 410

NEW PENTIUM II PROCESSOR AT 400MHz

- (Dual Processor/RAID Capable)
- 128MB 100MHz ECC SDRAM
- 4GB Ultra-2/LVD SCSI Hard Drive
- 1000LS 17" (15.9" vis) Monitor
- Diamond 8MB AGP Video Card
- 32X Max Variable CD-ROM Drive
- Integrated Sound Blaster Pro Compatible Sound
- 3Com Fast EtherLink XL 10/100 PCI NIC with Remote Wakeup
- Remote Client Manageability Support via DMI 2.0; Wakeup on LAN Capable
- MS Windows NT Workstation 4.0
- 3-Year NBD On-site Service; 1-Year NT Support
- 7x24 Telephone and Online Support

\$3799

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actual remediation. In some cases, Y2K features were added on to an established product, whereas other products were designed from the ground up for locating Y2K problems.

Prices on the products we surveyed range from \$29.95 to \$6,000 (list). But you can find anything from freeware utilities to suites costing five figures. If you're charged with securing a large investment in a costly enterprise-wide system, you might want to spend extra for one of the high-end solutions that come with on-site consultation services.

Some of the tools—WRQ's Express 2000 Suite, for one—assist with the inventory of your applications to help

prioritize your Y2K efforts. Other tools, such as OnMark 2000 Assess and IST Year 2000 Packs identify date-sensitive areas in files, such as places where date math or date functions are used. This kind of tool helps you assess your Y2K risks and focus your remediation efforts.

Some tools, such as DateSpy from AMS Group International, are application-specific. DateSpy finds Y2K date issues in Microsoft Excel spreadsheets only. Other utilities are collections of related tools. McAfee 2000 Toolbox from Network Associates, for example, not only finds date-related problems in spreadsheet and database files, but also identifies noncompliant applications and

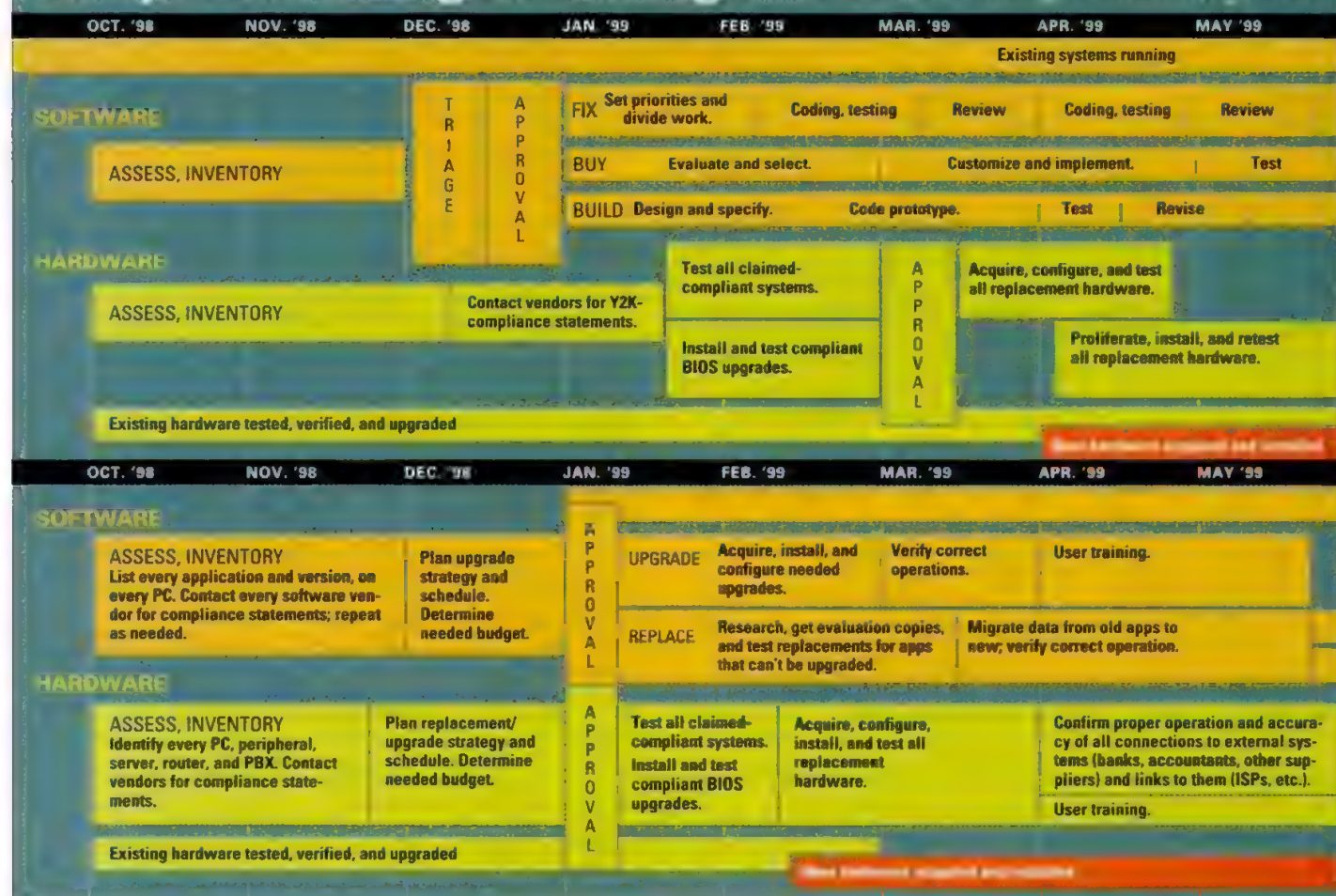
scans PCs for Y2K-specific viruses. Several packages here, including OnMark 2000, Express 2000, and 2000 Toolbox, also include a BIOS testing utility (see "Testing Your PC Hardware").

If you have more than a handful of PCs and applications to audit, you'll likely want a tool that also works across a network, and one that provides the flexibility to sort and group results according to different criteria. You'll want reports that are geared toward management, and others for the technicians or end users who will be doing the actual remediation. Good reports will help you deploy an organized Y2K SWAT team. For the most part, all of these products have good, flexible reporting capabilities.

DateSpy aims to meet the needs of both end users and Y2K specialist teams by offering both a standard version with few configuration options and a professional version with granular control over how

GOOD REPORTS WILL HELP YOU DEPLOY AN ORGANIZED Y2K SWAT TEAM.

Sample Scheduling for Dealing with Y2K



files are scanned. 2000 Toolbox, with its wizard-driven interface, targets end users. Year 2000 Packs is geared toward LAN administrators and PC-support personnel who need a network-based tool to analyze many different file formats.

Choosing the right tool for the job means considering your environment, the number and types of PCs you must test, and how well you and your Y2K team have analyzed usage patterns for applications and data. Tools that give you more flexibility in defining a Y2K date problem and that provide more detail will make your job easier when you have to repair the affected files.

A HANDLE ON Y2K COMPLIANCE

WRQ's **Express 2000 Suite** is a network-based software inventory and metering package that matches programs against a database of more than 6,000 applications to determine levels of compliance (800-

872-2829, www.wrq.com;). Express 2000 (\$65 list per seat, 25 seat minimum) also runs a Y2K BIOS test on your networked PCs. Express 2000 stores information in a Microsoft Access database, which includes canned reports that can be sorted and filtered to help you assess your Y2K vulnerability and prioritize a resolution strategy.

The program also indicates which vendors have patches or upgrades to make their applications compliant. And, when used with the bundled Express Meter, Express 2000 lets you track and even block the usage of apps deemed noncompliant—to help you control future Y2K risks.

Similar to Express 2000, Network Associates' **McAfee 2000 Toolbox** reports on application compliance, but it focuses only on applications with Y2K compliance issues (800-332-9966, www.nai.com). 2000 Toolbox provides concise descrip-

tions of Y2K issues in the noncompliant applications along with workarounds that help you circumvent the problem, such as always using four-digit years in Excel.

2000 Toolbox also lists other versions of the affected software and links to vendor Web sites for additional compliance information. But for \$29.95 (list), you also get a BIOS test-and-fix utility, database and spreadsheet analysis, virus scanning, and a number of general system security features.

2000 Toolbox borrows heavily from the Y2K features in Network Associates' ZAC (Zero Administration Client) Suite desktop asset-management product. Where ZAC Suite is aimed at networks and large corporations, however, 2000 Toolbox is aimed at end users and small businesses. It is completely wizard-driven.

The database and spreadsheet analysis features in 2000 Toolbox locate Y2K date problems in Microsoft Excel, Access, and

smaller ones (businesses) would benefit from trying out their plans on a timeline. Here are suggestions to help.

JUN. '99	JUL. '99	AUG. '99	SEPT. '99	OCT. '99	NOV. '99	DEC. '99	JAN. 2000
Coding, testing	Review	Test	Wider test	Revise	Test	Proliferate, move to live system. User training.	
	Revise	Wider test	Revise	Wide test	Revise	Proliferate, move to live system. User training.	
Test	Revise	Test	Wider test	Revise	Wide test	Revise	Proliferate, move to live system. User training.

User training.



For Larger Businesses

Most larger businesses already have Y2K-compliance programs in motion—by necessity—because many of their mission-critical applications are built on large customized applications, and sometimes customized hardware. Use this schedule to help identify any holes there may be in your plan. Don't forget about all those desktop PCs.

JUN. '99 JUL. '99 AUG. '99 SEPT. '99 OCT. '99 NOV. '99 DEC. '99 JAN. 2000

Inquire, review, monitor all suppliers' Y2K readiness.

User training.

Examine all spreadsheets and databases for 2-digit year dates; reenter as 4-digit dates as needed; verify.

Cutover to new PBX if needed.



For Smaller Businesses

In smaller businesses, problems are more insidious, because they may be less obvious or seem less complex. Even off-the-shelf applications can have problems, though, especially if you've customized them. And a few PCs aren't much trouble, but if it's more like a few hundred or more, that's a logistics challenge on top of a technical one.

FoxPro, Visual dBASE, and text files, plus many more. The package can even repair basic formatting problems (such as dates formatted with two-digit years) in your files. It does not have the sophistication and flexibility of other file-analysis tools we sampled but does a decent job of finding Y2K problems on individual PCs.

Check 2000 PC from Greenwich Mean Time-UTA LC scans key areas of PCs, including the BIOS, operating system, applications, and user data files, and reports on date dependencies and advice for getting around Y2K issues (703-908-6600, www.gmt-uta.com). For \$49 (list), you

get a mature Y2K tool that provides workarounds for many of the 5,000 applications that have been tested first-hand.

Check 2000 PC runs as a wizard, so end users can scan their own PCs, and it includes a BIOS fix utility. After checking your hardware, it scans selected drives for applications and data files. Like 2000 Toolbox, Check 2000 PC does not let you fine-tune your data-file scans, but rather identifies the data files on your PC and leaves it up to you to assess the issues.

The online help includes tips on locating and dealing with date-related problems. Reports show workarounds for

specific applications, but also let you drill down to detailed explanations of each date issue, giving you more ammunition to tackle those Y2K problems.

Check 2000 PC provides useful information to assess your Y2K risk, but look to Check 2000 Client Server for remediation help. The client/server version runs on a network and automates much of the data collection and scanning in addition to delving into data files to find date issues. When it does find a date problem in a file, it assists with remediation by letting you launch the app, correct the data, field mask, or format, and continue scanning.

TALK TO MANAGEMENT

HOW TO

Many large companies have all sorts of Y2K-compliance programs underway. But in most medium-size to small companies, Y2K crises are a distant, foggy possibility—not something worth worrying about today.

By Jim Seymour

The National Federation of Independent Businesses says only one small business (up to 100 employees) owner in four considers Y2K a serious problem. A survey commissioned by the Federation and Wells Fargo Bank

can you do this without seeming geeky or paranoid? Here's our advice:

Explain the problem to your boss.

Often, managers outside the computing industry just don't "get" Y2K. So help them. Explain how date calculations based on erroneous or ambiguous year-dates can wreak havoc with production, billing, payroll, benefits.

Do your own mini-assessment.

Check the BIOS on your PC and another dozen in your office. Make a list of the most important apps and which versions are installed. Check the Y2K-compliance status on vendors' Web pages. If you can show that a significant percentage of your computers and programs aren't ready, you'll have a lot more credibility.

Get some realistic numbers.

Check some of the Web sites listed in our sidebar "Year 2000 Web Sites." Pull together statistics that suggest the risks of noncompliance. Have these numbers ready and put together a one-page "leave-behind" summary.

Talk about corporate liability.

It's clear that in the blizzard of litigation ahead, corporate officers and directors are going to be at personal financial risk for not having done enough to anticipate, assess, and remediate Y2K problems. Insurance won't protect against these

suits, nor will it defend them, settle them, or pay judgments. Make sure your company's managers understand their risks.

Propose a realistic time line.

It's already too close to January 1, 2000, but you can lay out a crash-course time line that will give your company a chance to perform triage, decide what must and can be fixed, and what will have to be allowed to fail. Management will think in terms of weeks; you know this will take much, much longer, since it will need to be done on top of other work. (Use our suggested timelines as a start point.)

Construct an emergency plan.

Even if you expect to have all your company's systems compliant in time, you'll still need a formal, written crisis plan. Perhaps some of your fixes will be incomplete. Perhaps you'll miss a few critical spreadsheets. Talk to management from day one: Know what you'll do, when and how. If that means paper systems—well, grit your teeth and recommend them.

Avoid geeky claims and solutions.

Sure, you're something of a PC expert, and you understand why and how Y2K arose. Your management isn't and doesn't. If you're perceived as just trying to get more money for whizzler PCs or expensive new apps, you're going to be ignored. Put a business case forward. You'll be a lot more successful.



showed that of small businesses aware of the Y2K crunch, almost 40 percent don't intend to do anything about it.

If you work in a business that isn't addressing Y2K today, or maybe plans to do something later on, you have a real self-interest in helping your management get religion about the risks of not facing Y2K problems now. But how

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While you may love the Web, you probably don't know too much about how it works technically — a fact that many web sites take full advantage of. So while you're viewing one of their pages, they're secretly dumping files onto your computer. Like cookies. Little ID tags that let them monitor your activities on their site. And beyond.

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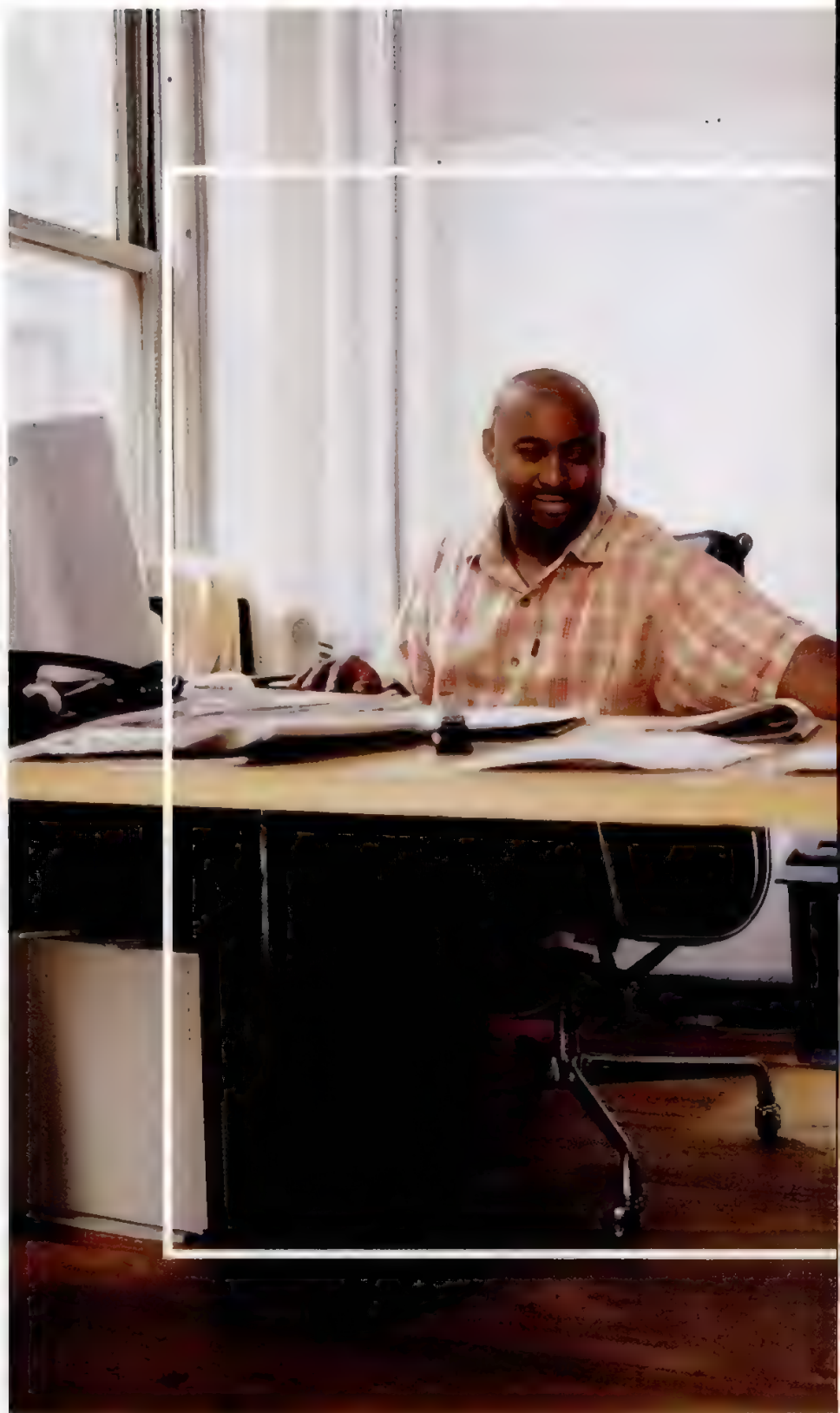
Windows NT Workstation is more reliable, because it allocates separate memory space for each app. So if one app goes down, the rest stay up. Which means Bob in marketing won't be calling you today to tell you he's done it again.

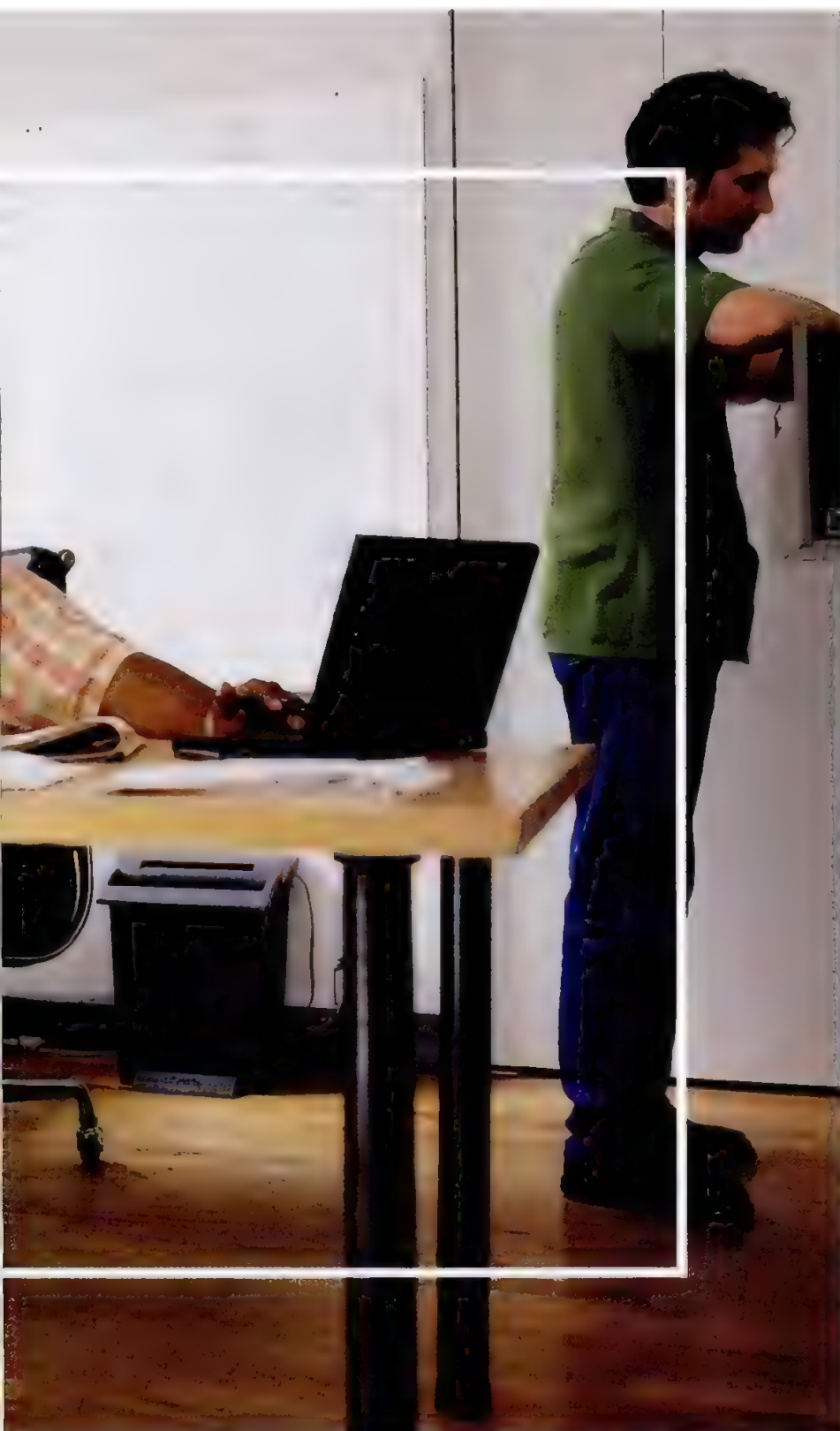
Windows NT Workstation gives you better security options. Your data stays yours. Your users get access to what they need (and only what they need).

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THE WHEAT FROM THE CHAFF

Although Y2K utilities that analyze data files are usually very good at finding date-sensitive areas in files, no tool can entirely predict how you'll use the data and which areas pose the most risk. This is where the analysis by your crack Y2K team comes in. If you know your data and how it's used, then you can configure your analysis tool to avoid searching for date-related information that you know poses no risk.

Right out of the box, these analysis packages will give you lengthy reports of every possible Y2K problem in your files. This may be a good report to show

management as a wake-up call, but when it comes time for remediation, you'll want to focus on the most severe threats first. All packages in our sampling provide methods for fine-tuning your analysis in an effort to minimize the number of false-positives.

DateSpy from AMS Group International locates date-sensitive values, formats, formulas, and macros in Excel spreadsheets, Visual Basic modules, and OLE or DDE links (888-779-2174, www.datespy.com). The standard version (\$39.95 list) is ideal for end users who need to perform basic Y2K assessment of

spreadsheets. The professional version (\$69.95 list) is well suited to IT specialists who need to narrow down scans by selecting target words, date ranges, date formats, and types of modules to search.

DateSpy requires that Excel 5.0 or later be installed on the scanning PC, and it generates detailed reports in Excel format. A report summary page shows the number of workbooks, sheets, and modules found using your search criteria. The report's detail area shows what values were found in which modules, the cell locations, and the formats and formulas that were used on the values. This

ACCOUNTING SOFTWARE

ASSESS YOUR

Your accounting software has been processing your purchasing and accounts payable transactions for the past few years without any major problems. Now it's mid-1999 and suddenly you can't enter a purchase order for materials due for delivery in early 2000 (as if you needed another problem in your busy schedule).

This is just one example of the problems your accounting software may throw at you prior to the millenium rollover. Because accounting software commonly deals with future dates, this may be your first indicator of Y2K troubles.

By Tom White and Jim Holifield

As January 1, 2000, gets nearer, various business transactions may cross the millennium and present problems. Many businesses collect credit card expiration dates, insurance policy effective dates, and other types of information that involve future dates.

Signs that your accounting software is not Y2K compliant can include the inability to enter a date past 12/31/99, reports sorting or aging incorrectly, and inaccurate date calculations. Imagine creating a customer invoice that is

nearly 100 years overdue.

Y2K is a technology issue, but its nature and impact are far more broad. Not only must you ensure that your systems are compliant but also that your business partners' systems will not let you down. If your suppliers have Y2K problems, you may not receive your products on time.

To avert these problems, many business are sending out Y2K compliance questionnaires to their suppliers and key business partners in hopes of identifying potential problems.

Steps to Mitigate Y2K Problems

BEGIN PLANNING FOR Y2K NOW:

- Your year 2000 problems may begin much sooner than January 1, 2000.
- As we get closer, you may require key resources that will probably be busy assisting other companies.

ASSESS YOUR CURRENT SOFTWARE:

- Inventory your existing accounting software and all other applications that interface with it. Include custom enhancements or add-in modules.
- Contact software developers or vendors (or resellers) to ensure that the software you have is Y2K compliant. You may need to verify the version of each accounting module (GL, AP, and so forth). Check the vendors' Web sites for Y2K info.
- For those applications whose developers can't be contacted, determine the programming tools and database package (including version numbers) used to develop the applications, and contact the vendors of each to determine if these versions are Y2K compliant.

TEST Y2K COMPLIANCE:

- If possible, set up a test company that is entirely separate from your live company.
- Enter sample transactions for late 1999 and early 2000. (You may need to close 1998 in the test company.) Run the transactions through their full cycle and assess the outcome of each.
- You should test even if the vendor assures you that its software is Y2K compliant—many packages include bugs even in enhancement releases.

PREPARE A CONTINGENCY PLAN:

- Find ways to continue operating the business if the worst scenario occurs. (This could mean using paper.)
- Expect problems.

THINK OUTSIDE OF THINGS:

- Consider delaying any significant IS projects during late 1999 and early 2000 so that your IS staff can deal with any unexpected problems.
- Contact key business partners to determine their readiness (and therefore your risk) regarding Y2K. Questionnaires are helpful, but for key partners, personal contact is preferred.

ACCOUNTING AT RISK

Although the year 2000 mess may be better known as a problem for government and large businesses, medium and small businesses using packaged accounting software are not immune.

Mainstream suppliers of business accounting software are providing upgrades to their applications. Many of these vendors have bundled their Y2K fixes with other enhancements in new versions or releases. At least one accounting software vendor, Great Plains Software, boldly provides a formal warranty at its Web site stating that all date-related functions in its current products will support the year 2000 rollover (www.gps.com).

Not surprisingly, some vendors and resellers are generating significant revenues by weaning their existing users from old versions of their software to new Y2K-compliant versions. You may be



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provides an excellent jump-start for eradicating Y2K issues.

Leaning toward the higher end and targeting Y2K specialists, **IST Year 2000 Packs** from IST Development is designed to run on a network and supports more file formats than any other package we tested (617-988-6251, www.istinfo.com). Priced at \$6,000, it comes with CenturyPack modules for analyzing Microsoft Access, Fox-Pro, and Excel; Lotus Approach and 1-2-3; and various languages, including Visual Basic and C/C++.

Year 2000 Packs requires that Microsoft Office Professional 95 or 97 or Lotus

SmartSuite 97 be installed on the scanning workstation, depending on the types of files you're scanning. It can scan across almost any network type from any PC that has access to the network drives. Keyword searches are completely configurable so you can narrow down the scope of your search to target high- or moderate-risk constructs, or to all date issues.

You can also customize the search to target user-defined functions or foreign language terms. And Year 2000 Packs supports three levels of scanning: a basic list of files that match search criteria, a summary analysis in which files are cate-

gorized by date-sensitivity, and a detailed analysis that provides a file-by-file and line-by-line account of all date-sensitive issues. A separate DateReporter module scans Clipper, dBASE, and Paradox tables for date-related issues.

Similar to Year 2000 Packs, but on a smaller scale, is **OnMark 2000 Assess** from Viasoft (888-842-7638, onmark.viasoft.com). OnMark 2000 (\$75 per user, list) uses a very fast scanning engine to locate date-related problems in popular spreadsheet and database files and unstructured text files. The package centers its analysis around five levels of severity that you can

charged for an upgrade to your software and possibly for its implementation. This has not sat well with some customers. The year 2000 will be a litigious issue in many ways, as we describe elsewhere.

Business software that is custom-written or provided by a company you have not heard from in years may bring other challenges. If your vendor is out of business or has not yet provided a Y2K upgrade, you'll need either to test your software rigorously or switch your software package. But whatever you do, do it soon—time is getting short. Moreover, as we get closer to Y2K, software vendors may find their implementation and support resources overloaded.

Many companies have had their accounting systems customized or have developed add-on modules to address functions not supported by the standard accounting software. These enhancements are precisely where some Y2K surprises can lurk. Even if your software is able to support the year 2000, any customized features must also be evaluated.

As you're working on your Y2K compliance, assess what impact an accounting system failure would have on your business and develop a contingency plan. Think worst-case scenario and involve users in the planning process. Don't be afraid to consider low-tech (or no-tech) solutions to keep your business running.

Accounting software is just one link in the year 2000 chain. But with Y2K, you can't afford to miss one weak link.

Some Leading Accounting Packages

Package	Y2K-compliant version	Release date
Accpac International Inc.; 800-773-5445, 408-562-8800; www.accpac.com		
Accpac for Windows	: All versions	September 1994
Great Plains Software; 800-456-0025, 701-281-0550; www.gps.com		
Great Plains Accounting	Version 7.0 and later	1993
Dynamics	: All versions	1993
Intuit Inc.; 800-446-8848, 650-944-6000; www.intuit.com		
Quickbooks	Version 6.0 and later	June 1998
Quickbooks Pro for Windows	Version 6.0 and later	June 1998
Macola Software; 800-468-0834, 740-382-5999; www.macola.com		
Progression DOS	Version 6.2 and later	March 1998
Progression Windows	: Version 7.0 and later	1996
Open Systems Inc.; 800-328-2276, 612-403-5700; www.osas.com		
Open Systems Accounting Software	Version 6.0 and later	Prerelease, August 1998, general availability October 1998
Traverse	Version 8.3 and later	Prerelease, August 1998, general availability, October 1998
Peachtree Software Inc.; 800-228-0068, 770-724-4000; www.peachtree.com		
Peachtree 2000	: First version	March 1998
Peachtree Complete Accounting for Windows	Release 6	June 1998
Platinum Software Corp.; 800-997-7528, 949-727-4005; www.platsoft.com		
Platinum for Windows	Version 4.6 and later	December 1997
Platinum SQL	: All versions	May 1992
RealWorld Corp.; 800-678-6336, 603-641-0200; www.realworld.com		
Classic Accounting	Version 7.5 and later	December 1997
Expertise SQL	: All versions	July 1998
Sage Software Inc.; 800-854-3415, 949-753-1222; www.sota.com		
Business Works	: Version 12	September 1997
MAS 90 (Windows 95, NT, and DOS)	: Varies by module, verify that your product's release date is February 10, 1998, or later	: February 1998
Acuity	: All versions	October 1996
SBT Accounting Systems; 800-944-1000, 415-444-9900; www.sbt.com		
SBT Pro Series	Version 3.2 and later	March 1997
SBT Executive Series	Version 1.0 and later	December 1996
Scala North America Inc.; 888-722-5241, 407-875-6999; www.scala-na.com		
Scala	Version 4.1 and later	September 1996
Solomon Software Inc.; 800-476-5666, 419-424-0422; www.solomon.com		
Solomon IV for Windows (Scalable SQL)	Release 2.06 with Service Pack 2 or later	February 1998
Solomon IV for Windows (MS SQL Server)	Release 2.5 with Service Pack 3 or later	: February 1998
Syspro Impact Software Inc.; 800-369-8649, 714-437-1000; www.sysprousa.com		
Impact Award	: Version 3.2 or later	February 1998
Impact Encore	: Version 3.2 or later	February 1998

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customize to focus on your real date issues rather than on phantom problems.

OnMark 2000 also scans embedded Visual Basic code in Excel and Access files to uncover buried Y2K issues. The intuitive interface makes Y2K analysis approach-

DATESPY LETS you specify which target strings and date ranges to search for and whether to search macros or VB modules.

able by almost any level of user, and the collapsible reports provide the flexibility to drill down to various levels of detail.

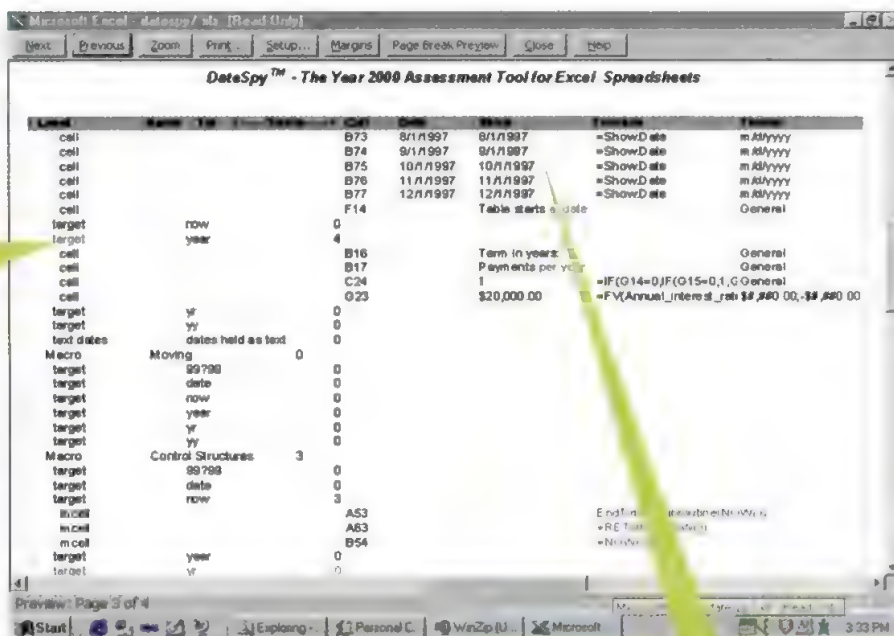
In addition to these and other products, the **Norton 2000** package should be available from perennial utilities player Symantec Corp. in both a corporate version (\$69 list per node, with volume discounts) and a retail version (no price yet) for end users as you read this (800-441-7234, www.symantec.com). Norton 2000 will do BIOS scanning and fixing as well as application and data scanning and will produce customizable reports to help users repair severe problems. Norton 2000 will scan many popular software programs.

THE FIX

For the most part, you'll need to fix date problems in your applications and data manually. The purpose of these programs is to help you identify where the problems are and provide some guidance. If your application is not compliant, you'll need to upgrade, patch, or replace it, or in some cases, employ workarounds or recode it. If your data is not compliant, you will either have to expand date fields or change the way in which data is manipulated to account for four-digit years.

Only a few of the general-purpose Y2K analysis tools include automated remediation features. But some are parts of larger suites that have remediation tools or target specific languages, such as COBOL. Vissoft, for example, offers several interactive Workbench utilities for programs such as Access, Excel, and PowerBuilder, plus Visual Basic and C/C++, that integrate with OnMark 2000 and help you to automate and shorten the remediation process.

Over the next year, you're sure to see many more players in the Y2K tools arena. Some will be veteran Y2K consultancies and utility developers who have packaged their in-house tools for use by the general public. Along with a clear, organized Y2K



plan, one of these tools will surely make you less fearful of the coming millennium.

And be sure to bookmark **PC Magazine's** year 2000 Web site—www.pcmag.com/y2k—for developing information on Y2K issues and products.

REPORTS SHOW

which modules, sheets, and cells contain the target strings along with the values, formulas, and formats used in the given cells, so you know how to remediate any problems.

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BIGGEST WORRY

By Jim Seymour

Troubles ranging from some kind of disruption to total disaster have been forecast for many industries, as a result of year 2000 noncompliance. From banking to distribution, health care to retailing, securities trading to telecommunications, you can find Y2K disaster theorists chanting mantras of doom as the calendar rolls over to January 1, 2000.

Some industries have done more than others to get ready—the securities industry gets the prize for best early preparations. But some industries are simply more critical than

electrical power in your area for an extended period, you're in deep trouble.

The power industry's big problem lies in embedded systems, which are in fact, part of everyone's Y2K problem. "Embedded systems" is shorthand for the billions of programmed microprocessors (*programmable logic controllers*, or PLCs) hidden inside nearly every piece of sophisticated equipment in use today. Your car has hundreds, power plants have many thousands—or more.

All PLCs contain software code, which is almost always impenetrable to the people who own and operate the systems. Worse for the companies that produced those PLCs, that code is often badly documented—if at all.

So utilities have the job of tracking down all these PLCs, though the companies have no idea how many PLCs there are, where they are, or what precise role they play in process control. They must then test each one for Y2K compliance. If the embedded systems are not Y2K-compliant and are not specifically upgradeable, the whole piece of machinery has to be replaced. Not only can that be a crushing and expensive burden, but many of these machines must be ordered years in advance.

Get the picture?

Given all that they have to do, the power companies must have made a good start on this, working on Y2K problems for years, right?

In January, the Public Utility Commission of Texas surveyed the state's 176 generation and distribution companies on their Y2K readiness. Only 44 percent responded. None were yet compliant, and none had any clear idea when they *would* be. Among Texas electric co-ops, only 18 percent had written plans for Y2K preparations, and 24 percent said they hadn't yet *begun* planning. So the PUC, which has absolute regulatory control over these agencies, roared back with a list of recommendations, including "contin-

ing to monitor Y2K issues" and putting up a Web page about the problem.

Hmmm. Better stock up on candles and batteries, Texans.

Other states? In May, Florida Power & Light reported that two-thirds of the way through its Y2K remediation schedule, it's about halfway finished. In Pennsylvania, the \$2 billion electric utility Conectiv brags that it will spend all of \$5 million to fix its Y2K problems, and it has 7 programmers working on its 25 million lines of code. But the 7 programmers will be able to check and fix only a small fraction of those 25 million lines.

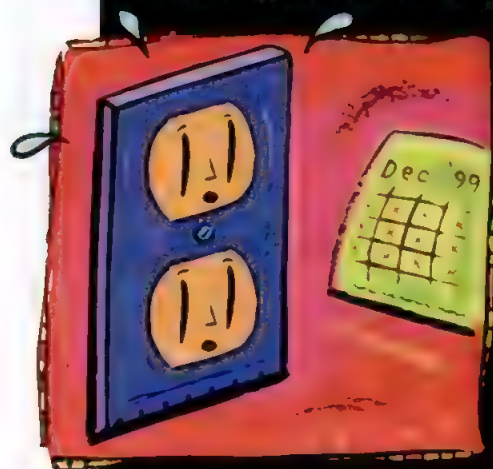
More: About 20 percent of U.S. electric power comes from nuclear plants. But the Nuclear Regulatory Commission is required by law to shut down plants that cannot show they can operate safely. In June, the NRC wrote the operators of America's 108 nuclear plants, demanding a statement of compliance, or concrete plans to *be* compliant by the end of 1999. The number of compliant plants so far: 0.

Another 40 percent of U.S. power comes from coal-fired plants. But coal plants require an immense, steady supply of coal, which arrives daily via huge strings of rail cars. Railroad-car movements in this country are controlled by aging computers and hidden embedded systems.

In addition, about 30 percent of our electricity comes from gas-fired generators. Natural gas is controlled by systems built around PLCs. And the gas industry has not been a leader in Y2K preparations.

Still, it would be unfair to say that electric utilities have done nothing. Many have spent a great deal of time and money, invariably on fixing their *billing* systems for Y2K.

What are we going to do? No one knows. Many power-industry experts admit privately that they think large-scale and extended power outages, beginning in January, 2000, are inevitable. And one more thing: January 1, 2000, is in the dead of winter. ☐



others. Whose problems will matter the most?

I'm betting on—against, that is—the power industry. I award that booby prize for two reasons, and in the language of logicians, both reasons meet the "necessary and sufficient" test. That is, either on its own would be plenty cause for worry, but the combination of the two looks especially bad.

First, the electric-power industry has an enormous amount of work to do, and it is doing a terrible job of getting ready for Y2K.

Second, no matter the remediation work on systems in every other industry—getting elevators working, fixing telecom switches, updating thousands or millions of PC BIOSs—if there's no



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17- AND 19-INCH MONITORS

Bigger & Better

With monitor quality up
and prices way down,
the shift to larger screens is on.
PC Labs tests 76 monitors designed
for business pros.

By Alfred Poor

here's a new standard in desktop displays: The 17-inch monitor will supplant the 15-inch as the display most buyers choose this year. And 19-inch monitors—new to the market and barely a blip on the sales charts in 1997—should account for 5 percent of all CRTs shipped in the U.S. for 1998. What's fueling the growth? Although there have been a few technological advances in this market segment since we covered it a year ago, the biggest news is price: Your dollar buys more screen real estate than ever before, and the quality of that real estate has never been better.

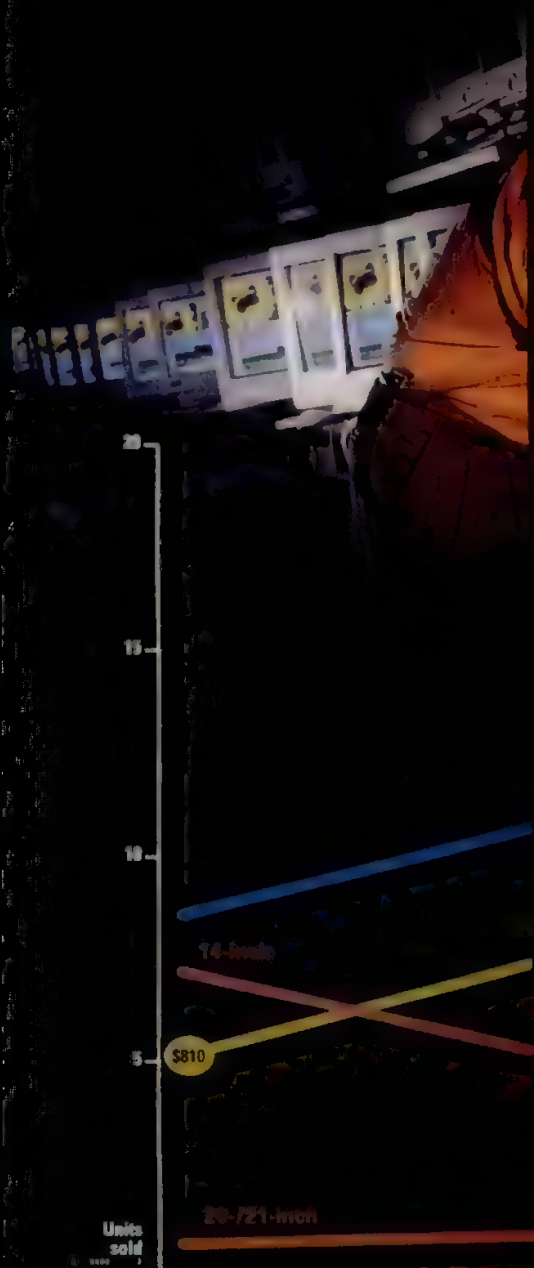
As the accompanying chart shows, prices for CRT monitors have been dropping steadily and dramatically. The average street price of a 17-inch monitor in 1996 was \$810, according to Stanford Resources, a San Jose-based market research firm. That has dropped to \$440 this year, with some units (the MaxTech XT-7861 and the Pixie 770, reviewed here) priced as low as \$250—a price more often associated with 15-inch monitors. And 19-inch units have followed suit. Last year, the typical price for these newcomers was \$915; today, you can get a good unit, such as the Compaq V90 or Gateway VX900, for around \$525.

YOU GET MORE THAN YOU PAY FOR

You might think that these lower prices come at the cost of image quality or features, but we were pleasantly surprised to find that the majority of the monitors we tested produced good to excellent images, and that most of the image-quality differences were subtle. In fact, among the 76 monitors we tested, we found only a handful that we would wholeheartedly *not* recommend. The rest are fine for most day-to-day business chores (word processing, number crunching), and many are suitable for the more demanding tasks of image editing and CAD design. Our ratings, found in the special pullout section "Monitor Buying Guide" clearly show which of the units we tested are appropriate for each type of work.

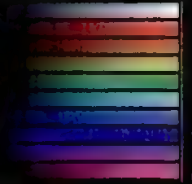
This improvement in image quality is mostly about refining existing technology, but there are some new advances to report. The most significant is a small-footprint format for 13- and 10-inch models that to the

Close inspection Project leader S. Jae Yang checks the monitors' settings in preparation for our jury panel.

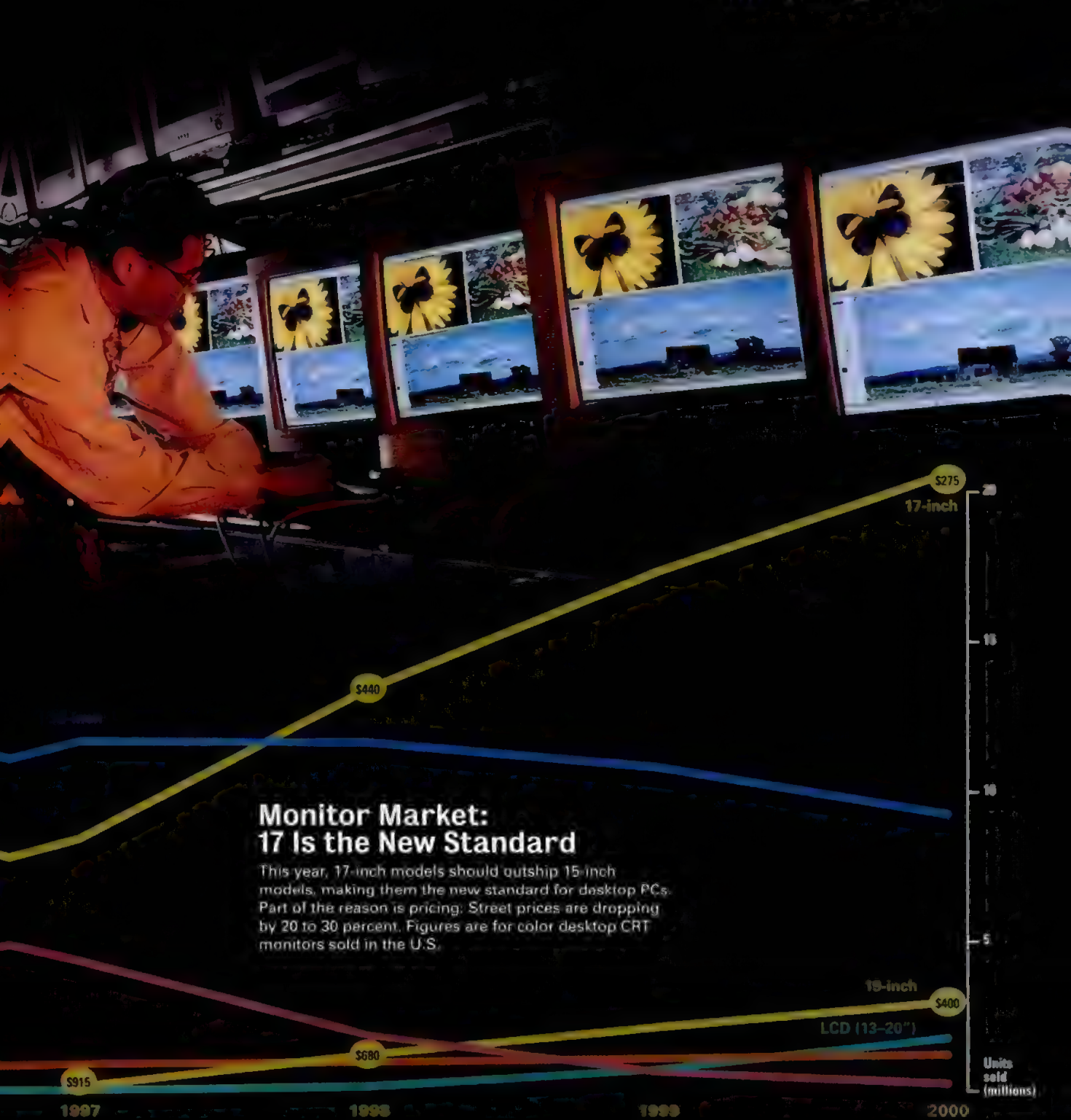


Test Your Monitor Online

Visit the PC Magazine Web site and download some of the same DisplayMate test images our technicians used in our labs. See if your monitor is up to snuff.



www.pcmag.com



Average selling prices for 1998 and 1997 and projections for 1999 and 2000. 10-inch monitors were not available in 1998. Source: Monitor, from Stanford Resources; www.stanfordresources.com.

17- and 19-inch Monitors

We invited the largest 40 vendors (by U.S. monitor market share) to submit one 17-inch and one 19-inch monitor. Packard Bell and Sampo were between cycles and opted not to participate. We also invited the top 10 vendors of 17-inch models to submit a second 17-inch unit, since that's the sweet spot of the market right now.

Acer Peripherals America Inc.	165	IBM Corp.	194	Philips Consumer Electronics Inc.	203
ADI Systems Inc.	177	Iiyama North America Inc.	194	Pixie Technologies Inc.	203
Apple Computer Corp.	177	Impression Products Inc.	195	Princeton	208
Compaq Computer Corp.	177	KDS USA	195	Proton USA Corp.	207
Cornerstone Peripherals Technology Inc.	177	LG Electronics	197	Samsung Electronics America Inc.	207
CTX International Inc.	180	MAG Innovision	197	Shamrock Peripherals Inc.	208
Daewoo Electronics Corp. of America	180	MaxTech Corp.	199	Smile International Inc.	208
Dell Computer Corp.	180	Mitsubishi Electronics America Inc.	199	Sony Electronics Inc.	208
EIZO-Nanao Technologies Inc.	193	NEC Technologies Inc.	200	TechMedia	209
Gateway Inc.	193	Nokia Display Products Inc.	201	TeleVideo Inc.	210
Hansol Multitech Inc.	193	NSA-Hitachi	201	ViewSonic Corp.	210
Hewlett-Packard Co.	194	Optquest Inc.	202	Editors' Choice	185
Hyundai Electronics America	194	Panasonic Computer Peripheral Co.	202	Monitor Buying Guide	185

beam no more than 90 degrees from one side to the other. This typically results in a monitor case that is about as deep as the diagonal measurement of the screen itself. That can become a problem in cramped cubicles or home computer nooks as users move up from a 15-inch display, which most office furniture was designed to accommodate.

Matsushita was the first company to come out with a 100-degree deflection yoke CRT for PC displays, used in a handful of monitors in this review (including the 17-inch Panasonic PanaSync SL70 and 19-inch Cornerstone c900). The design saves about 2 inches of depth, which means that a 17-inch monitor has the same footprint as a 15-inch monitor, and a 19-inch model fits in the space that a 17-inch unit would occupy. Other CRT manufacturers, including Hitachi, are expected to have wide-deflection tubes on the market soon.

Wide deflection is not the same as *short neck tube*, which refers to the use of smaller components at the electron-gun end of the picture tube. This reduces the depth of the CRT by about an inch—not as much as a true wide-deflection design, but still enough to be worthwhile. In this roundup, the 17-inch CTX PL7+ and the 19-inch EIZO-Nanao FlexScan FX-D7, among others, employ a short-neck design.

Hitachi had the 19-inch tube market all to itself last year, but that has changed. Whereas last year only 7 19-inch models were ready in time for this feature (all using the Hitachi CRT), in this roundup we test 29 models using tubes from Hitachi, Matsushita, Mitsubishi, Philips, Sony, and Toshiba.

Another notable trend, especially for Windows 98-equipped users, is the increasing popularity of USB ports on monitors. These ports (usually two or

four, built into the monitor's base) let you use the monitor as the hub for connecting the USB devices now coming out: mice, keyboards, scanners, speakers, videoconferencing cameras; and soon digital cameras, printers, and storage devices like the LS-120 SuperDisk and Zip drives. Of the monitors here, 11 include USB ports standard, and 18 offer them as an option (typically \$50 to \$100). Two intelligent designs, from EIZO-Nanao and NEC, let you buy a non-USB monitor now and add

a USB module down the road, without having to replace the entire monitor. This is especially desirable for corporate accounts that want to standardize on one monitor while equipping some of their users with USB.

VARIATIONS ON A THEME

For the most part, we're still working with the traditional monitor-design choices. You can choose between standard shadow masks, in which the colored phosphor dots are arranged in triads, or aperture-grille designs, in which the phosphors are arranged in vertical stripes, as in the Sony Trinitron and Mitsubishi DiamondTron tubes. (We explain these and the benefits of each in more detail in the pull-out section.) Be aware that the aperture-grille tubes have one or more horizontal tensioning wires inside that cast a faint shadow on the display's face, especially on an all-white screen. Some people find this effect objectionable, while others do not notice it at all. Be sure to see it for yourself before making a final choice.

One problem with having so many different designs is coming up with a fair way to compare them. The spacing of the phosphors is a critical element in image quality, because the size and spacing of the dots or stripes (referred to as the *dot pitch* or the *mask pitch*) determine the maximum resolution that the monitor can display with accuracy. The horizontal dimension of this spacing is the most critical, so starting with this feature, we will report the spacing in terms of the *horizontal pitch*. This measure may differ from the pitch specification published by the manufacturer as the industry slowly switches over from reporting *diagonal pitch*, but it provides the most meaningful measure that can be used to compare dif-

Black level is the amount of brightness retained when the video signal is set for zero, or complete blackness. Poorly engineered brightness controls prevent the black level from fully deactivating the pixels, causing a faint gray hue in areas that should be black.

Convergence is a measure of how precisely aligned a monitor's red, green, and blue electron guns are. If the guns are misaligned, the resulting misconvergence will cause unwanted color halos around object edges.

Degaussing demagnetizes a monitor's tube to reduce picture distortion.

Gray-scale shift is a measure of the change in the brightness level of gray areas on screen when adjacent areas alternate between dim and bright states. Well-engineered monitors show little or no bleed from adjacent areas.

Moiré patterns are wavy, silk screen-like effects caused by a mismatch between the pattern of a monitor's shadow mask or aperture grille and the horizontal line pattern of the image.

Screen regulation refers to the stability of the dimensions of a monitor's display area. In a poorly engineered monitor, the screen image can bow or otherwise change in size and shape.

Video bandwidth, the amount of data dedicated to projecting an image onto your monitor screen, is allocated into horizontal and vertical scan rates. We measure the quality of each monitor's bandwidth using a Video Bandwidth Index test, which compares the horizontal bandwidth against the vertical. Below 80 percent, the display tends to be gray or blurry.

Monitor Terms

Editors' Choice

- 17-inch: EIZO-Nanao FlexScan TX-C7, NEC MultiSync E700
- 19-inch: iiyama VisionMaster Pro 450, Nokia 446Xpro, Optique V95



Though there are many good monitors among the 76 models we tested, 5 stand apart (2 17-inch and 3 19-inch

models) in this very competitive field.

Our Editors' Choice for the best 17-inch monitor for business users is the NEC MultiSync E700 (\$550 street). The second generation of NEC's innovative CromaClear slot mask CRT delivered unsurpassed text and photo images on our tests. Adding to its appeal is the optional tilt/swivel base that NEC offers. You can replace the standard base (now or down the road) with either a multimedia unit with built-in speakers by Altec Lansing (\$79 list), one with a powered four-port USB hub (\$79 list), or one with both (\$129 list). Top image quality at a midrange price put the E700 ahead of the others; This obsolescence insurance is icing on the cake.

The EIZO-Nanao FlexScan TX-C7 (\$800 street), our Editors' Choice for graphics users, offers similar flexibility: It can be fitted with a snap-on stereo speaker module (\$70 street) or USB hub (\$100 street); both fit beneath the front bezel. But this monitor's real strength is its front-of-screen performance: Its aperture-grille tube produced arguably the best images in this roundup, and it was ranked among the

best in all-around image quality by our jury panel. The TX-C7 is a high-end monitor and is priced accordingly, but for graphics and CAD professional who need the best tools of the trade, this is it.

Two other 17-inch monitors also fared well with our jury and merit honorable mention here: the Mitsubishi Diamond Pro 87TXM (\$540 street), and the Sony CPD-200GS Multiscan (\$580 street). If you can't quite justify the cost of the EIZO monitor, one of these should still satisfy. More price-sensitive buyers should take a look at the Hansol 700P (\$400 street) and the Shamrock C709 M5 (\$430 street). These each placed on our jury rankings and deserve special recognition as the best-performing models we tested under \$450.

If you're a business or home user trading up to a 19-inch monitor, the Editors' Choice-winning iiyama VisionMaster Pro 450 (\$700 street) and Optique V95 (\$600 street) are our recommendations. These models delivered excellent images for text and graphics chores at prices we consider a bargain.

Higher-end graphics and CAD users will want to look at our final Editors' Choice, the Nokia 446Xpro (\$900 street). No 19-inch model did better on our objective tests and jury analysis. Honorable mentions go to two entries that performed nearly as well as the Nokia model, while costing less: the Compaq V90 (\$530 street) and NSA-Hitachi SuperScan Elite 751 (\$780 street).

ferent tube designs accurately.

We present the horizontal pitch information in the specifications paragraph prior to each product review. This paragraph also includes the highest resolution a monitor can deliver at a comfortable refresh rate. The *refresh rate* (cited in hertz) indicates how quickly the electron guns repaint the screen. We've found that a rate between 75 Hz to 85 Hz best balances a flicker-free image with top image quality. Note that in most cases, the monitor can handle lower resolutions at increasingly higher refresh rates (we cite the manufacturer's refresh rate for the most popular PC resolutions in the "Summary of Features" table).

You'll find reviews of 76 17- and 19-inch monitors here, covering a broad range of prices, features, and missions. If you're looking for a bigger, better picture for your computer applications, you've come to the right place.

AcerView 79g, 99c

79g: 17" aperture-grille tube (0.25-mm stripe pitch), 1,600-by-1,200 (75 Hz); \$450 street. **99c:** 19" Invar shadow-mask tube (0.23-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz), \$600. San Jose, CA; 800-452-2237, 408-432-6200; www.acerperipherals.com; 501 at www.pcmag.com/infolink.

● These two business-class monitors deliver decent performance at attractive prices. Although neither will set any image-quality standards, both are good choices for general office work.

The AcerView 79g is a solid but not outstanding choice for the mainstream business desktop, and the aperture-grille tube may win over some image editors. The 79g performed well on most of our tests, with rock-solid screen regulation

and a nearly ideal score of 94 percent on our Video Bandwidth Index test. In real-world applications, edges were less crisp than they could have been. We also saw halos, streaking, and noticeably squashed circles, all of which affect CAD/CAM applications and line graphics.

The four-button menu controls are confusing and difficult to learn, but the menus themselves offer a wealth of features, including moiré and misconvergence controls. For mainstream business users who like aperture-grille CRTs, the AcerView 79g is certainly a reasonable choice.

The AcerView 99c performed well on many of our tests, offering rock-solid screen regulation and excellent color

Our Contributors BRUCE BROWN, ALFRED POOR, and M. DAVID STONE are contributing editors of *PC Magazine*. ROBERT S. ANTHONY and CADE METZ are staff writers, and JOSH LEVY is the staff editor for the hardware peripherals team. DON LABRIOLA is a frequent contributor to the magazine. S. JAE YANG was the project leader, and JAMIE M. BSALES was the senior associate editor in charge of this story.

PERFORMANCE TESTS

17- and 19-Inch Monitors



Across two levels of subjective evaluation and a suite of objective color analysis tests, we saw a number of very good monitors at every price level. Very few models did poorly on our tests.

In last year's *PC Magazine* review of 17- and 19-inch monitors, the majority of contenders posted satisfactory scores on our objective tests. Because of this, we decided to change our methodology in this year's roundup, limiting our machine-based measurements to luminance and color uniformity analysis. For image-quality testing, we relied more on our eyes—the ultimate judge.

We ran each monitor through an exhaustive battery of test images using the industry-standard DisplayMate program from Sonera Technologies (800-932-6323, www.displaymate.com). Then, based on the DisplayMate performance, our reviewers nominated the best 17-inch and 19-inch monitors for inclusion in a final round of jury testing. The jury was composed of computer users who had no familiarity with the particular monitors being reviewed; in addition, company and product names were covered during the test. When the jury was through with deliberation, the only monitors left standing were the winners among winners.

Among the 17-inch monitors, the favorites included our Editors' Choice winners, the EIZO-Nano FlexScan TX-C7 (for its high-quality photo display) and the NEC MultiSync E700 (for its crisp text and good contrast on images). The jury favorite among 17-inch units was the Mitsubishi Diamond Pro 87TXM, which impressed reviewers and jurors alike with its crisp and flawless text. The IBM P72, number 2 on our jury tests, ranked consistently high in both of the business applications used in the jury tests (Microsoft Word and Excel). Jury standouts among the 19-inch monitors included the NSA-Hitachi SuperScan Elite 641 and the IBM P92, as well as our Editors' Choice winners, the Nokia 446Xpro, Optique V95, and iiyama VisionMaster Pro 450.

We also recommend that you take a close look at our objective data. You'll soon find that many of the objective test results don't easily translate into similar scores on the jury test. But these aberrant objective scores likely point to issues of some significance, and they may play a role in usage environments other than the ones in which we tested. For instance, a narrow color range could be a problem if you're a graphic artist designing a brochure; you might not be able to see all the colors you're actually generating. This issue would not necessarily have arisen in our labs during testing in Word, Excel, and Adobe Photoshop.

Looking at the results from this point of view, we can, for example, make a case for rating the 19-inch IBM P92 ahead of the jury test-winning Hitachi SuperScan Elite 641, which has an unimpressive luminance of 20.4 fL and a much higher luminance variance than the IBM unit. In choosing your monitor, start with the ones we recommend based on our subjective findings and jury-test results; then refine your decision by considering the objective measurements and the features.—*Analysis written by S. Jae Yang*

▲ High scores are best. ▼ Low scores are best. Bold type denotes first place. ■ denotes Editors' Choice					
	Video Bandwidth Index (%) ▲	Luminance (foot-lamberts) ▲	Luminance Variance (%) ▼	Color Variance (%) ▼	Color Range (% of 350 RGB) ▲
17-INCH MONITORS					
AcerView 79g	94	29.0	4	6	57
ADI MicroScan 5P+	89	12.1	3	10	53
Apple Multiple Scan 720	87	27.7	8	4	53
Compaq V75	93	35.5	6	9	58
Compaq P75	92	28.3	2	6	58
CTX PL7+	84	15.8	6	7	54
CTX PR710	86	23.3	12	17	55
Daewoo 707B	85	31.2	8	6	57
Dell UltraScan 1000LS	87	33.0	6	7	58
Dell UltraScan 1000HS	86	34.2	7	5	58
■ EIZO Nano FlexScan TX-C7	98	30.2	4	5	58
Gateway VX700	97	29.0	5	13	58
Hansol 700P	83	28.0	5	5	54
HP 70	90	37.1	7	4	55
Hyundai DeluxScan 7695B	91	27.8	8	5	55
IBM G72	89	28.5	4	7	55
IBM P72	91	28.5	3	2	58
iiyama VisionMaster Pro 400	89	28.3	4	4	57
Impression Vienna Pro 75	80	N/A	N/A	N/A	N/A
KDS AV-7T	92	24.2	5	5	34
LG GoldStar Studioworks 771	88	27.4	10	4	58
MAG DJ717	89	23.6	9	7	58
MAG XJ700T	77	26.8	5	4	58
MaxTech XT-7861	91	12.0	6	9	54
Mitsubishi Diamond Pro 87TXM	92	28.8	4	5	57
NEC MultiSync A700	84	36.9	9	5	57
■ NEC MultiSync E700	95	27.2	7	7	54
Nokia 447XiPlus	90	26.1	4	4	58
NSA-Hitachi SuperScan Elite 641	79	26.2	8	7	57
Optique V75	82	27.5	9	5	57
Panasonic PanaSync SL70	91	26.3	5	7	66
Panasonic PanaFlat PF70	90	23.8	6	9	59
Philips 107MB	84	25.4	17	12	58
Pixie 770	84	28.3	6	6	61
Princeton EO720	97	23.3	18	11	55
Princeton EO750	98	34.7	14	6	55
Proton MM-750i	88	27.3	5	7	53
Samsung SyncMaster 700b	95	32.9	4	6	55
Samsung SyncMaster 700p Plus	95	27.7	6	5	62
Shamrock C709 M5	94	21.0	4	6	57
Smile CA8738SL	80	23.7	9	13	51
Sony CPD-200GS Multiscan	93	37.2	12	7	58
Sony GDM-200PS Multiscan	99	25.8	7	10	59
TechMedia Ventanna 770	78	34.3	11	5	56
TeleVideo SVP270	97	35.8	1	4	58
ViewSonic G773	94	26.5	6	8	58
ViewSonic PT775	97	23.6	1	5	57

N/A—Not applicable. The product arrived too late to include in low-level testing.

▲ On the Video Bandwidth Index, the Sony GDM-200PS, EIZO-Nano FlexScan TX-C7, and Princeton EO750 were close to perfection. In luminance, most of the monitors were in the acceptable range or better. Five 17-inch units fell into the excellent range (35 fL or above).

Every 17-inch model we tested

fell into the acceptable range for luminance variance. The TeleVideo SVP270, ViewSonic PT775, and Compaq P75 showed almost no variation in luminance across the screen. Again on our color variance measure, all of the 17-inch models were in the acceptable or excellent range, led by the IBM P72.

In today's techno complicated, seemingly "me-too" world of monitors, how can one know which are truly better?



Act on the judgement of a higher authority.

And the winner is . . .

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Consistently, time after time, iiyama is deemed "best" by the experts charged with judging the world's finest monitors.

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PCWORLD, April 1998

*"The screen display had impeccable focus from corner to corner,
and it passed all our small-font torture tests with ease"*

PCWORLD, April 1998



The iiyama VisionMaster Pro 450 and the VisionMaster 450

And a few more won by our 19" monitor.



4-Star Rating
May 1998,
VisionMaster 450



July 1998,
VisionMaster 450



Perfect Five-Star Rating
January 1998
VisionMaster 450



Five-Star Winner
August, April 1998,
VisionMaster 450

History, demanding to repeat itself.

Performance-designed for photo retouching, color prepress, desktop publishing,
business applications CAD/CAM, and other demanding applications.



Just introduced, the iiyama VisionMaster Pro 502

Some of the industry awards our predecessor 21" monitors have garnered.



Technical Excellence
March 1997
VisionMaster Pro 21



Six Time Winner
June, May, April,
March, February, January 1997
VisionMaster Pro 21



Perfect Five Star Rating
January 1998
VisionMaster Pro 500

*And we only needed a
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skinny little jewel.*

But with a very big 18" screen,
we're putting in a new wall of trophy cases.



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Trophy case . . . under construction.

*Now it's time for the only
performance that really counts.*

Time for you to put an iiyama trophy on your desk.

For those of you who need a little
more technical persuasion.

	CRT monitor Model/ Viewable Area	TCO	Dot Pitch/ CRT Type	Max Horizontal Scan Rate	Maximum Resolution
21"	VisionMaster Pro 502 (19.5" VIS)	TCO'95	0.28mm/AG	110khz	1800x1440@74hz
21"	VisionMaster Pro 501 (19.5" VIS)	TCO'95	0.28mm/AG	96khz	1600x1200@75hz
21"	VisionMaster 502 (19.5" VIS)	TCO'95	0.27mm/dp	110khz	1800x1440@74hz
21"	VisionMaster 501 (19.5" VIS)	TCO'95	0.27mm/dp	96khz	1600x1200@75hz
19"	VisionMaster Pro 450 (18.0" VIS)	TCO'95	0.25mm/AG	102khz	1400x1200@80hz
19"	VisionMaster 450 (18.0" VIS)	TCO'95	0.26mm/dp	102khz	1600x1200@80hz
17"	VisionMaster Pro 400 (16.0" VIS)	TCO'95	0.25mm/AG	96khz	1400x1200@75hz
17"	VisionMaster 400 (16.0" VIS)	TCO'95	0.26mm/dp	96khz	1600x1200@75hz
17"	S702GT (16.0" VIS)	TCO'95	0.28mm/dp	96khz	1280x1024@65hz
15"	VisionMaster Pro 350 (13.7" VIS)	MPR-11	0.28mm/dp	69khz	1280x1024@60hz
	TFT/LCD monitor Model	TCO	Pixel Pitch	Max Horizontal Scan Rate	Maximum Resolution
18.1"	ProLite 46a (wall mount available)	TCO'95	0.2805mm	80.5khz	1280x1024@75hz
15.0"	ProLite 38a (with OSD)	TCO'95	0.279mm	62.5khz	1024x768@75hz
15.0"	ProLite 38b (with OSD, USB, speaker)	TCO'95	0.279mm	62.5khz	1024x768@75hz
14.1"	ProLite 36a (with OSD)	TCO'95	0.279mm	62.5khz	1024x768@75hz
14.1"	ProLite 36b (viewing angle 80 degree)	TCO'95	0.279mm	62.5khz	1024x768@75hz

No other monitor company gives so much quality product for the price. With over 100 major industry awards won, a full 3-year warranty backing every unit, and a focused product line to provide the shadow mask, aperture grill and newest LCD technologies, you can't make a better monitor decision than iiyama.



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PERFORMANCE TESTS

▲ High scores are best.
▼ Low scores are best.
Bold type denotes first place.
■ denotes Editors' Choice

19-INCH MONITORS	Video Bandwidth Index (%) ▲	Luminance (foot-lamberts) ▲	Luminance Variance (%) ▼	Color Variance (%) ▼	Color Range (% of full RGB) ▲
AcerView 99c	73	23.9	6	8	57
ADI MicroScan 6P	79	29.8	7	8	58
Compaq V90	78	23.2	7	5	58
Cornerstone c900	80	23.8	6	6	57
CTX VL950	83	27.1	10	9	59
Dell 1200HS	93	24.6	7	7	58
EIZO-Nanao FlexScan FX-D7	80	25.8	11	6	59
Gateway VX900	78	21.0	5	7	59
Hansol 900P	75	29.7	10	7	59
HP M900	79	26.5	9	14	59
IBM P92	80	32.4	6	4	59
■ Iiyama VisionMaster Pro 450	83	29.7	6	9	58
LG 99T	79	31.9	3	5	60
MAG XJ810	86	31.4	6	9	57
MaxTech XT-9881	91	27.1	10	12	58
Mitsubishi Diamond Scan 90a	74	26.8	6	5	58
NEC MultiSync E900+	82	29.5	21	7	59
■ Nokia 446Xpro	84	32.5	3	4	58
NSA-Hitachi SuperScan Elite 751	100	20.4	11	8	59
■ Optique V95	74	33.0	5	12	59
Panasonic PanaSync SL90	84	23.3	9	8	57
Philips 109 S	94	21.8	6	5	58
Pixie 995	78	26.5	2	3	59
Princeton AGX900	96	29.1	1	3	58
Samsung SyncMaster 900p	78	27.5	2	4	58
Smile CA8929SL	68	35.7	7	10	59
Sony GDM-400PS Multiscan	80	30.0	3	4	59
TeleVideo SVP300	100	23.9	8	7	59
ViewSonic PS790	79	22.0	6	6	58

▲ The 19-inch monitors from NSA-Hitachi and TeleVideo showed perfect Video Bandwidth Indices. The Smile CA8929SL showed a disturbingly low index of 68 percent. In its favor, it was the brightest 19-inch model we tested, with a luminance score of 35.7 fL.

In luminance variance, the 19-inch Princeton AGX900, Pixie 995,

and Samsung SyncMaster 900p all fell into the excellent range. All but one of the tested monitors met the acceptable level: The 19-inch NEC MultiSync E900+ showed disturbingly high variance. The IBM P92, Pixie 995, and Princeton AGX900 demonstrated the lowest color variance among 19-inch monitors. None crossed the threshold of unacceptability.

How We Tested

We used Number Nine Revolution 3D graphics cards with 8MB of memory each as the standard source of video signals. For our test-bed, we used several 200-MHz Micron Millennias, to each of which was attached an Extron P/2 DA6 VGA Splitter. From each splitter we delivered a common signal to up to five monitors simultaneously.

Our reviewers used **DisplayMate for Windows** to set up, tune, and subjectively evaluate each monitor. Key attributes observed during testing included screen uniformity, moiré control, color registration, focus, geometry linearity, local regulation, screen regulation, line and bar resolution, and video bandwidth. Although we are not reporting numerical results of these tests (with one exception), they were used as the primary basis for the written reviews. The exception—DisplayMate's **Video Bandwidth Index** test—is an intensity ratio of high-frequency vertical lines to horizontal lines. The number is a good indicator of the electron gun's ability to raise and lower the intensity to an accurate level quickly as it scans horizontally.

JURY FAVORITES

■ denotes Editors' Choice

17-INCH MONITORS	Overall rank	Microsoft Word rank	Microsoft Excel rank	Photo-image rank
Mitsubishi Diamond Pro 87TXM	1	1	4	4
■ EIZO-Nanao FlexScan TX-C7	2	5	2	1
IBM P72	2	2	2	5
Nokia 447Xi Plus	4	3	1	7
Sony CPD-200GS Multiscan	6	3	5	2
Iiyama Vision Master Pro 400	6	6	6	3
Hansol 700P	7	7	8	6
■ NEC MultiSync E700	8	8	8	7
Shamrock C709 M5	9	9	9	9
19-INCH MONITORS				
NSA-Hitachi SuperScan Elite 751	1	1	1	2
IBM P92	2	3	1	1
TeleVideo SVP300	3	2	4	5
Compaq V90	4	4	4	6
■ Nokia 446Xpro	5	6	3	2
ViewSonic PS790	6	5	6	8
■ Optique V95	7	7	7	2
■ Iiyama VisionMaster Pro 450	8	8	8	5

▲ **La crème de la crème.** The 17-inch entries from Mitsubishi, EIZO-Nanao, and IBM (P72) rose to the top among the jury test field consisting of the best in DisplayMate evaluation. The Mitsubishi monitor was the most preferred for word processing, the 17-inch EIZO-Nanao excelled in displaying photographs, and the IBM P72 was

near the top in both Excel and Word display.

The NSA-Hitachi SuperScan Elite 751 dominated the best of the 19-inch monitors. The IBM P92 followed closely behind, as the jurors saw the monitor as indistinguishable in quality from the NSA-Hitachi 19-inch when displaying Excel sheets and even better in Photoshop.

On completion of the DisplayMate evaluation, the reviewers nominated the best monitors for the jury tests. We used real applications as test images. The monitors were set up in a glare-free environment with the logos and emblems covered up. We asked the jurors to evaluate the selected monitors in displaying a spreadsheet in **Microsoft Excel 97**, a document in **Microsoft Word 97**, and photographs in **Adobe Photoshop 4.0**. The display quality of each of the three screen images was graded "no flaw," "minor flaw," or "major flaw."

To perform the color analysis, we used a Minolta CA-100 color analyzer in a dark glare-free room. We set the monitors to 6,500° K by default or to 9,300° K when the lower setting was not available. (The temperature merely indicates the "tint" of the monitor's white screen.) We measured the **luminance** in foot-lamberts (fL) at the center of the white screen. A higher score indicates that a unit can produce a brighter image without compromising the contrast. A score of 35 fL or above is excellent, while less than 18 fL is unacceptable. We also report the **luminance variance** and the maximum **color variance** over various points on the screen. The luminance variance is calculated by dividing the standard deviation of luminance measurements by the average. The maximum color variance is the largest distance in color-space coordinates of two points on-screen. For both tests, less than 8 percent variability is excellent; 20 percent or more is unacceptable.

From the color measurements, we also calculated the **color range** each monitor was able to produce as a percentage of the theoretical maximum RGB range. A higher number indicates that the monitor can display a wider spectrum of color, but no monitor is expected to reach anywhere near 100 percent with existing phosphor technology.



FOCUS ON YOUR CUSTOMER

Customer-focused, customer-driven. Over the past decade, the giants of Corporate America have made the customer their strategic centerpiece, investing huge sums in information technology to help them improve their customer relationships.

And, what they've been saying is, 'We have to start treating our customers like small businesses do...with the same personal attention to their needs and the same ability to customize a product or a service.'

While big businesses are using technology to play catch up with companies with one, five, ten, or 20 employees, small businesses all over the world are finding out they can use those same solutions to build their advantage.

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Software solutions can help small businesses serve their customers better than ever, while at the same time helping them improve their own productivity. There are software solutions that not only put the power of information technology at their fingertips, but also protect customers from the problems that systems can cause.

Symantec has spent nearly two decades providing such solutions to individuals, businesses and other institutions around the world, making them more productive and keeping their computers safe and reliable — anywhere, anytime.

"With such revolutionary developments as corporate downsizing, computing and the Internet, the number of small businesses around

you more touch and feel when it comes to your customers?

Understanding

Customer-driven means that a business offers its customers products and services they really need, rather than presenting "a product in search of a market." The price is right; the packaging and shipping is the way they want it; their operation is 24 hours a day, so your support is too. The best businesses are the ones that understand their customers well enough not only to see all this, but also to see what's coming around the bend.

It's never been an easy task. You need to know your customer base by market or geographic segment, but that's not enough. You need to

tools can help you maintain the professionalism and personal touch you've been known for, reminding you and your staff about important customer dates and events.

Responsiveness

Responsiveness on a day-to-day basis says you provide customers with the answers they need when they need them. So sales and service people — no matter where they are — must have instant, easy access to customer databases and the ability to transmit quotes, presentations, and even training programs to customer sites. Access can also be speeded by technology that, for instance, enables caller ID to bring up the record before the sales or service person says "good morning."

It doesn't matter what information your customer needs and how fast, there's a communication vehicle for getting it there and you have to use it all: e-mail, voice mail, fax, overnight delivery. For instance, computer-to-fax is the fastest way to get your customers hard copy. We're talking about hard copy you send from your computer that might contain a just-assembled combination of the latest promotions and product illustrations.

Further, your customers should be able to access your systems to obtain the same information via e-mail or "fax on demand."

Voice mail? It's your image, they say, and technology exists for any size company to make sure you sound right, respond quickly, and keep a record of calls and faxes.

Productivity

Being able to provide your customers with better products and ever higher levels of service, being

Be understanding, responsive, productive and protective. This is what being customer-driven is all about.

the world has exploded," says Symantec's Dana Siebert, VP, Americas. "This is great because small businesses have always been a major source of innovation and service. A primary goal for companies like ours has to be to help level the playing field for them and contribute to their growth.

"What we're saying here is they have an advantage — their understanding of and responsiveness to their customers — and we think we can help them keep it."

The Touch and Feel of Technology

What does it mean to be customer-focused and customer-driven? How can technology give

know your customers individually and they need to feel that you do — that you know their business, you know them as people.

For instance, to create winning proposals over and over again, you want your customer's plans and the history of your relationship at your fingertips. We're not only talking volume, credit history, and the bottom line, but also the nuances of how you have worked together.

Technologically, both the top-down planning and the individual interaction require a customer database: an information file on your customers and their accounts — the notes, the phone discussion logs, the presentations and proposals.

As your company grows, software

able to develop and retain close relationships with individual customers as your customer base grows — all this carries a cost to your business. You can't stay customer-driven as we've described if your resources are strained and your bottom line suffers.

The technology solutions we've noted above — the customer and prospect database, word processor, e-mail messaging and other communications tools such as computer-to-fax and the calendar — are also crucial productivity tools for your organization, allowing them to be responsive to customers literally at the push of a button.

To improve ease-of-use, while safeguarding your investment in new and older computing equipment, such tools must operate on all major computing platforms.

These tools are win-win solutions for the front lines of your business — the people who plan and deliver what the customer needs. You also need technology that protects your business and your customer's, and solutions exist for your back office to provide these safeguards.

Protection

Flash...computers are vulnerable and fallible. They crash, wiping out that 10-page proposal you hadn't saved. They can get viruses. Installing new programs can mess up your system. Worse, you can wipe out data on your customer. And, electronically connected to your customers, you can send them a virus that wreaks havoc on their systems.

The good news is that technology solutions exist to fend off these problems.

Small Business Solutions



ACT!™ keeps contacts, your correspondence, and results. This customer and contact management software provides instant access to critical information about your customers, and appointment and business calendar alerts to remind you of important dates. ACT! supports Internet and e-mail services and lets you share information with your team.



WinFax PRO™ gives you flexible faxing right from your computer, allowing you to send products, quality books, including materials from your ACT! database, to one or more customers. You can also accomplish by attaching faxes for off-hour hours. WinFax Pro Fax Sharing features WinFax Pro to share fax modems and phone lines with other WinFax PRO copies on the network.



TaskWiz PRO™ means a more professional image for small businesses with up to five employees. This value and fax communications software provides fax scheduling, routing your customers to the your customer and create faxes of promotions, price sheets, and other information. Away from your office? TaskWiz PRO can call you with messages or fax messages. Call numbers, multiple customers and call management. Looking at calls and faxes.



eAnywhere™ helps you build building, customer relations, no matter where you are. From your first office in Detroit, you can carry on electronic sessions with your customers in New York, sending them training programs or presentations from your laptop or the corporate computer. eAnywhere PRO lets you take your customer data on the road with you. Many security features are built in.



Norton AntiVirus™ eliminates today's and tomorrow's viruses. Norton AntiVirus is the best protection for you and any customers you are connected to electronically. PC Magazine, in giving this product the Editor's Choice award this year, called it "the best combination of virus protection, performance, and security." Testing laboratories confirm that it provides 100% detection of "in the wild" viruses from any source, such as the Internet, floppy disks, and shared files.



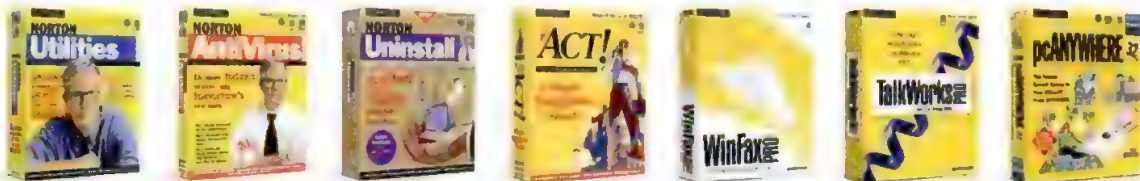
Norton Utilities™ provides advanced problem-solving power and control by detecting, repairing, and interrupting most computer problems. A trusted solution for more than 15 years, Norton Utilities continuously monitors your system to help you find the cause which ability to launch when there's a problem. "What about crashes and disaster recovery downtime?" As PC Magazine has stated, "Norton Utilities is 'The Industry Master' in protection against crashes—more than as effective as competitors—and provides advanced disaster recovery capabilities."



Norton Uninstall™ Deluxe is the safest way to remove or restore programs and files. It makes shared files intact and removes unwanted software for programs that are moved or copied. You can always restore what you've just discarded. Some damaged backups or very deleted are saved. The Uninstall feature lets you test new programs safely.



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#09-71-00290-A

HARDWARE

17- and 19-inch Monitors

photo handling. But moiré patterns, obvious halos, a slight reddish tint, plus less-than-ideal focus and text readability keep it out of the top tier in this roundup. Still, this monitor offers acceptable performance for mainstream business users looking to trade up to an affordable 19-inch monitor.—*M. David Stone*

ADI MicroScan 5P+, 6P

5P+: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$300 street. **6P:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$550. San Jose, CA; 800-228-0530, 408-944-0100; www.adiusa.com; 502 at www.pcmag.com/infolink.

● ADI Systems' attractively priced monitors are fine for everyday business com-

image quality in Photoshop. CAD/CAM performance was middling, especially on our registration, geometry, and haloing test images. But if you use mainstream Windows applications, the ADI MicroScan 5P+ and 6P are certainly attractive options for your desktop.—*Cade Metz*

Apple Multiple Scan 720

17" Invar shadow-mask tube (0.28-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$499 list. Cupertino, CA; 800-538-9696, 408-996-1010; www.apple.com; 503 at www.pcmag.com/infolink.

● The Apple Multiple Scan 720 is a good choice if you want better-than-average performance for applications across the board at a reasonable price. The monitor

was a solid performer in our labs. Screen regulation was rock-solid, and we saw no streaking. Photo images were superb on our tests, making the unit a good choice for graphics professionals. Results on the focus test were acceptable; text, though not as crisp as on the best units we tested, was fine for most chores.

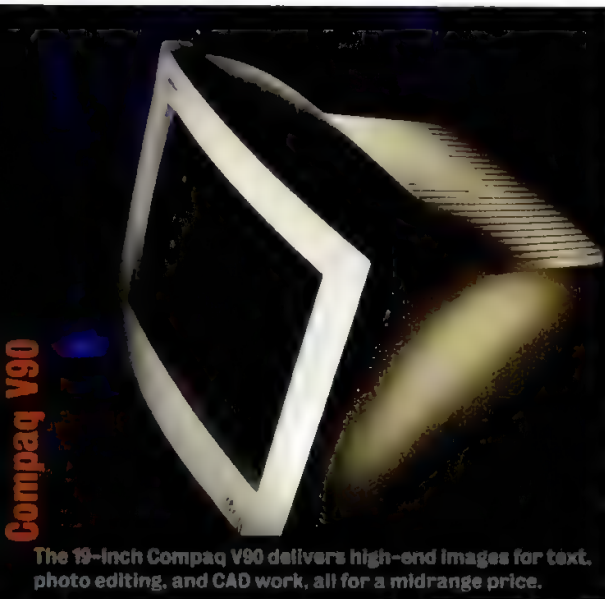
The controls are a little confusing, with a half-concealed thumbwheel that you must turn to the left in order to move menu selections or setting indicators to the right. Apple does include the adapter plug you'll need to

uncluttered look to the back (a nice touch for open office plans or reception areas).

The P75 is a mainstream business monitor designed for users who prefer aperture-grille CRTs and are willing to pay a premium to get one. This unit sailed through our labs tests. Our only criticism is that text showed a noticeable lack of crispness. On-screen controls (using an intelligent menu design) include extra choices, such as convergence, color temperature, and custom color adjustment. All told, the P75 earns its premium price tag, and except for the lack of text crispness, it delivers what it promises.

The V75 is aimed at the low-end business desktop. It did not perform as well as competing models from CTX, Optique, Princeton, and Samsung. Our tests showed misconvergence, moiré patterns, and a tendency for white areas to bleed into black areas, leaving text with a lack of crispness that might lead to eyestrain in long sessions. On-screen menus offered few choices beyond size, position, and geometry.

Compaq's 19-inch V90 is solidly targeted at the high-end desktop and delivers excellent performance. Text was highly readable on our tests, even at 7 points and below, and there were no problems with color photos or text when running typical applications. The only flaw serious enough to cause a problem in some circumstances was an obvious haloing effect. Still, the V90 is an attractive package, with excellent performance and a price that's a



Compaq V90

The 19-inch Compaq V90 delivers high-end images for text, photo editing, and CAD work, all for a midrange price.

puting. User controls on both monitors—

make this Mac model work with a PC. For

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12 pages per minute
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Maximum Print Area 8.5" x 14"

ELITE XL 608 LC

600 x 600 dpi resolution
8 pages per minute
1 year Platinum Exchange Warranty
Maximum Print Area 11" x 17"

GCC Elite 1212

GCC Elite XL 20/800

GCC Elite XL 608 LC

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All our printers are protected by our Platinum Exchange Program. Which guarantees that if during the warranty period you have a problem our support people can't solve, we'll send you a replacement printer by the next business day.

But your protection doesn't end there. GCC printers also come with a thirty-day unconditional, money-back guarantee. We even offer free technical support throughout the one-year warranty period, not just on business days, but Saturdays too.

Why do we go to such lengths? Our printers compete with some of the most famous names in the business. And like all smaller fish, we have to be nimbler than your average, better known-whale.

That's why we sell our printers direct. That way you pay for the printer instead of the assorted middlemen, and pocket the savings.

It's also why we offer value-added features such as AccuGray™ technology that reproduces halftones with unusual clarity and vividness. And why we offer a full range of printers that turn out poster-sized graphics, print shop-quality text, and perform various other noteworthy feats noted below.

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1200 x 1200 dpi resolution
8 pages per minute
1 year Platinum Exchange Warranty
Maximum Print Area 11.69" x 20"
Ledger, letter, legal, A3, A4, envelope
250 sheet Universal Tray
PostScript® Level 2 compatible, PCL 5
285 Post Script fonts, 15 PCL fonts
24 MB RAM expandable to 64 MB
EtherTalk®, TCP/IP
Ethernet (10 BaseT, 10 Base2), NetWare®
Parallel, LocalTalk™, RS422

2nd Paper Feeder*

(Includes 250 sheet Universal Tray) Add \$319
(Includes 500 sheet Letter Tray) Add \$419
Extra 8 MB Memory Add \$ 49

Platinum Exchange Warranty Program:

Additional Year Add \$259
Two Additional Years Add \$389

\$2599

Business Lease \$91 Month/36 month lease

ELITE XL 20/600

600 x 600 dpi resolution
20 pages per minute
1 year Platinum Exchange Warranty
Maximum Print Area 12.75" x 35.25"
Ledger, letter, legal, A3, A4, envelope
500 sheet Universal Tray
PostScript® Level 2 compatible, PCL 5
285 PostScript fonts, 15 PCL fonts
16 MB RAM expandable to 64 MB
EtherTalk®, TCP/IP
Ethernet (10 BaseT, AAUI), NetWare®
Bi-directional Parallel, LocalTalk™, RS422

2nd or 3rd Paper Feeder* Add \$ 299
(Includes 500 sheet Universal Tray)
Extra 8 MB Memory Add \$ 49

Platinum Exchange Warranty Program:

Additional Year Add \$ 179
Two Additional Years Add \$ 269

\$1799

Business Lease \$63 Month/36 month lease

ELITE XL 20/800

800 x 800 dpi resolution
20 pages per minute
1 year Platinum Exchange Warranty
Maximum Print Area 12.75" x 35.25"
Ledger, letter, legal, A3, A4, envelope
500 sheet Universal Tray
PostScript® Level 2 compatible, PCL 5
285 PostScript fonts, 15 PCL fonts
24 MB RAM expandable to 64 MB
EtherTalk®, TCP/IP
Ethernet (10 BaseT, AAUI), NetWare®
Bi-directional Parallel, LocalTalk™, RS422

2nd or 3rd Paper Feeder* Add \$ 299
(Includes 500 sheet Universal Tray)
Extra 8 MB Memory Add \$ 49

Platinum Exchange Warranty Program:

Additional Year Add \$ 199
Two Additional Years Add \$ 424

\$1999

Business Lease \$70 Month/36 month lease

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17- and 19-inch Monitors

than most seen here.

Image quality was generally good but not remarkable. In our labs, we saw some skewing of rectangular shapes in the upper-right-hand corner and some minor color registration problems near

were no glaring screen geometry or image problems, though a minor bit of moiré patterning couldn't be cleared by the moiré control. Screen convergence and focus were very good. The convenient brightness and contrast controls, the on-screen adjustments for other screen attributes, and the clear, fold-out user guide are commendable. For fine all-around performance on typical business applications, the PL7+ is an outstanding value.

The CTX PR710 is intended for business and professional users who sit in front of the screen all day long. Capable of balanced, fine performance with text, graphics, and photo images, the aperture-grille tube and very high refresh rates make spending a few extra dollars worth the investment in user comfort. In our testing, the PR710 showed consistently tight screen focus and rich colors.

If you're looking for a larger display, the CTX VL950 is very competitively priced. But, despite generally acceptable performance, it isn't at all appropriate for engineering or design work—nor would it be a good choice for all-day business use. In our labs, the VL950 showed moderate screen halos and high-contrast streaking, and focus that was just a bit off. Not an image standout, the VL950 delivers on size and price and may prove fine for general home use and gaming.—Bruce Brown

Daewoo 707B

17" Invar shadow-mask tube (0.24-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$260 street. Lyndhurst, NJ; 800-323-9668, 201-460-2522; www.dwa.daewoo.co.kr; 507 at www.pcmag.com/infoink.

● The Daewoo 707B delivers mediocre performance at a low, low price. Image imperfections keep it from being a top choice for long hours of use, but home users (especially gamers) looking for a light-duty 17-inch monitor at a 15-inch price might want to take a look at the unit. In our lab testing, text characters in Word and Excel were well-formed but a bit faint and fuzzy—more brown than black. In addition, the brightness control was unable to generate a completely black

background; white spaces were always a bit yellowish, never true white; and thin black lines were noticeably gray. In the 707B's favor, user controls are clear and easy to use, with a wide range of adjustable settings. Color registration on our tests was very good, and the screen geometry was fine. For the price, the Daewoo 707B is a reasonable choice—but only for a PC that doesn't see much action.—Josh Levy

Dell UltraScan 1000LS, UltraScan 1000HS, 1200HS

UltraScan 1000LS: 17" Invar shadow-mask tube (0.28-mm diagonal dot pitch), 1,024-by-768 (85 Hz); \$429 direct.

UltraScan 1000HS: 17" aperture-grille tube (0.25-mm horizontal dot pitch), 1,280-by-1,024 (75 Hz); \$629. **1200HS:** 19" FST (0.26-mm diagonal dot pitch), 1,600-by-1,200 (75 Hz); \$729. Round Rock, TX; 800-388-8542, 512-338-4400; www.dell.com; 508 at www.pcmag.com/infoink.

● This trio of Dell monitors offers good value across the board, with solid performance at middle-of-the-road prices. These three are unlikely to disappoint for typical business chores.

The Dell UltraScan 1000LS is a general-purpose business monitor with acceptable (though not outstanding) performance at an attractive price. Color images looked good and showed no noticeable convergence problems. We did notice strong halo effects, however, which make the 1000LS less useful for applications where the precise depiction of fine lines is important. The on-screen menus are relatively easy to use, and Dell includes analog knobs for quick access to the brightness and contrast controls. The 1000LS is a steady and predictable mainstream performer.

Built around a Sony Trinitron tube, the Dell UltraScan 1000HS is intended for graphical and detailed imaging applications. In our labs, the aperture-grille tube's video bandwidth showed performance comparable with the 1000LS (87 on our Video Bandwidth Index test, versus 86) but delivered better image quality. Focus was especially good, making text crisp and easy to read. This is a competent monitor, but we found other aperture-grille models—such as the Nokia 447XiPlus (\$499 list) and Sony CPD-200GS Multiscan (\$580 street)—that deliver better image quality at a similar price.

The 19-inch Dell 1200HS is also aimed at more demanding applications. It showed



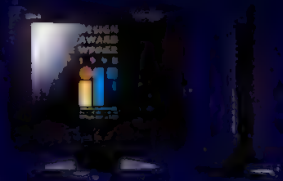
the top of the screen. Photos were rich in reds, to the point that some whites had a slight reddish tint. All in all, we preferred the iiyama and Mitsubishi 19-inch entries we tested, which sell for about \$50 less.—Robert S. Anthony

CTX PL7+, PR710, VL950

PL7+: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (87 Hz); \$360 street. **PR710:** 17" aperture-grille tube (0.25-mm stripe pitch), 1,024-by-768 (117 Hz); \$560. **VL950:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$600. City of Industry, CA; 800-888-2120, 818-839-0500; www.ctxintl.com; 506 at www.pcmag.com/infoink.

● If you're looking for a monitor with stable images for home and office work, CTX International has your number. All three units tested here offer crisp text and easy-to-use controls, but the 17-inch CTX PL7+ and PR710 offer the best value.

The PL7+ is a good buy for users who want multimedia features and reasonable performance in an aggressively priced monitor. Equipped with integral speakers and a headphone jack, the monitor comes with a connector that plugs directly into your sound card for low-volume business and performance audio. In our labs, image quality proved fine for text and general graphics work, with particularly good color photo image display. There



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21" Model#	DOT Pitch	Max. Resolution	Auto-Scan Range
Diamond Plus 100e	0.28 mm	1600 x 1200/85 Hz NI	H: 30-108 kHz V: 50-152 Hz
Diamond Pro 91TXM	0.28 mm	1600 x 1200/75 Hz NI	H: 30-95 kHz V: 50-152 Hz
Diamond Pro 1010e	0.26 mm	1800 x 1440/76 Hz NI	H: 30-115 kHz V: 50-152 Hz
Diamond Pro 1000	0.28 mm	1800 x 1440/76 Hz NI	H: 30-115 kHz V: 50-152 Hz

* DVI Diagonal viewable Image. Resolution refers to maximum addressable resolution H x V.

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Monitor Buying Guide

By Jamie M. Bsales

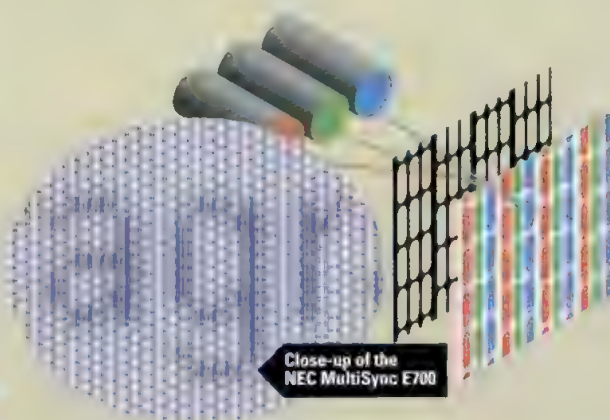
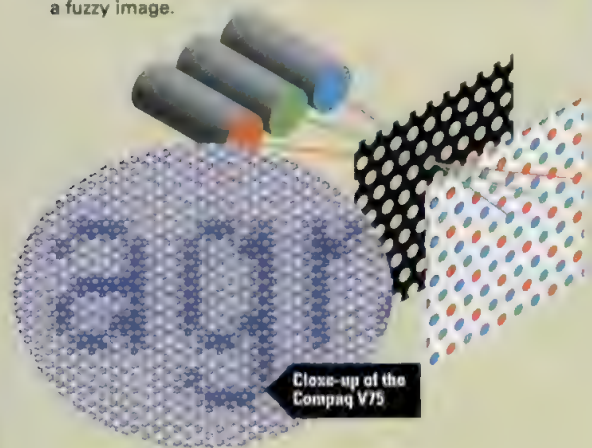
One of the essential components of your PC is the monitor: It will see more use than your hard disk, your keyboard, your mouse, and your printer—everything but the CPU. This pullout guide should help you in your purchase decision. We compare and contrast the three types of CRTs, illustrate the real-world differences among screen sizes, and include the Suitability to Task ratings for the 76 monitors we tested.

Tube Type Does Matter

The three types of CRTs have different strengths, and they are suited to different types of work.

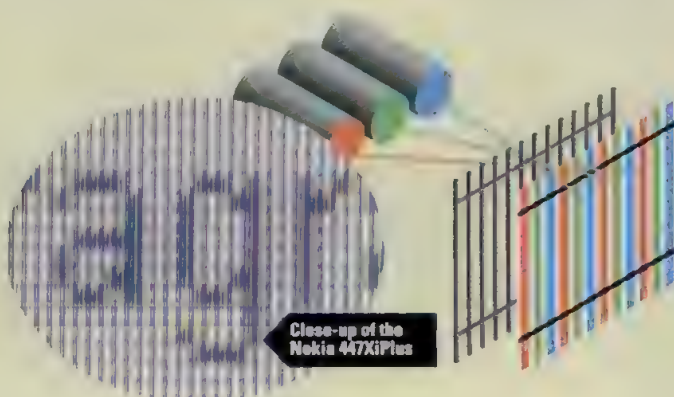
DOT-TRIO SHADOW MASK

This, the most common and affordable type of CRT, uses a thin sheet of perforated metal to create the discrete phosphor dots that compose the screen image. Because of the way phosphor dots are arranged, shadow-mask tubes deliver clean edges and sharp diagonal lines—important for crisp text reproduction. Look for a horizontal dot pitch (the distance between dots of the same color) of no more than 0.25 millimeters (0.27 mm if the diagonal measurement is cited). Any larger and the noticeable dot pattern will lead to a fuzzy image.



SLOT MASK

This hybrid tube was introduced by NEC three years ago under the name CromaClear. Instead of dots or stripes, it uses a mask that creates elliptical phosphor spots. NEC boasts improved sharpness and contrast in its CRT over traditional dot-trio designs. We found the first generation of CromaClear to offer little benefit over the competing designs. But the newest iteration did show impressive crispness during our testing.



APERTURE GRILLE

This type of CRT—made by Mitsubishi (DiamondTron) and Sony (Trinitron)—uses an array of stretched wires to create phosphor lines rather than dots. Aperture-grille units boast improved brightness and contrast over shadow-mask tubes without loss of focus. Better color saturation makes them the favorites for image editing. Note that all aperture-grille tubes employ hair-thin horizontal tension wires to hold their masks in place, invisible to some users but annoying to others.

an organization that includes powerhouses such as Compaq and ATI. But VESA, the standards body for the monitor industry, has yet to weigh in with a standard, and competing solutions from Sun Microsystems and others await evaluation.

Whichever digital standard (or standards) wins out on the desktop, the effect will be the same: The analog-to-digital converter in an LCD monitor will become unnecessary, and monitor electronics will be greatly simplified. This will result in a price drop to perhaps \$800 for a 15-inch monitor by the year 2000.

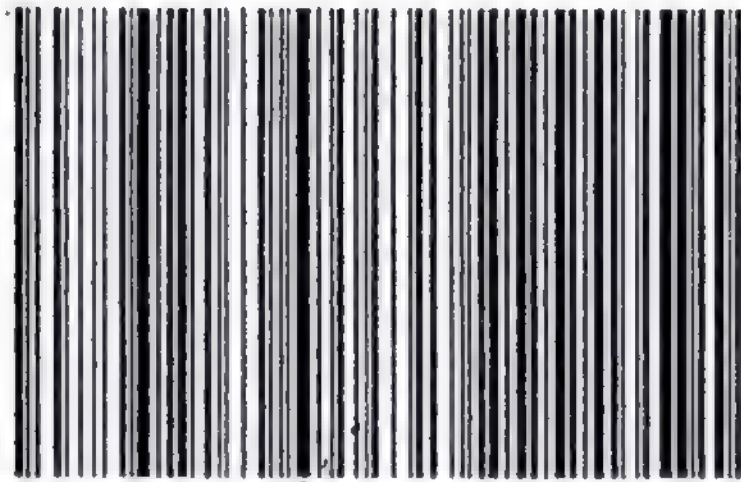
Some analysts believe that direct-view LCD monitors may only be a stopgap solution. One problem is that LCD component prices may not go much lower—probably not low enough to match CRT prices. There are other technologies on the horizon that may be able to compete on price more effectively. One leading candidate is the class of microdisplays, which use standard silicon semiconductor fabrication processes to build display devices on chips that are 1 inch square or less. The Texas Instruments micromirror Digital Light Processing (DLP) technology is the best-known example, but there are other reflective technologies coming from companies such as Colorado Micro Displays, DisplayTech, IBM, Pioneer, and S-Vision.

Some manufacturers predict that the display chips can be built for as little as \$15 apiece, even at high resolutions, compared with hundreds of dollars for the direct-view LCD panels. These display chips could be incorporated in small, rear-projection desktop monitors; a 20-inch high-resolution display could be housed in a case less than 12 inches deep and weighing less than 25 pounds. If priced competitively with 20-inch CRTs, these rear-projection displays could take over a significant part of the market. IBM and Raytheon have already demonstrated such products, and according to a number of microdisplay manufacturers, we may see retail products as soon as 1999. —*Alfred Poor*

Model	Price	Resolution	Refresh Rate	Response Time	Viewing Angle	Features	Overall Rating
Proton MM-750i	\$400	1024x768	60Hz	20ms	160°	Standard	Poor
Samsung SyncMaster 700b	\$380	1024x768	60Hz	20ms	160°	Standard	Fair
Samsung SyncMaster 700p Plus	\$450	1024x768	60Hz	20ms	160°	Standard	Good
Shamrock C709 M5	\$430	1024x768	60Hz	20ms	160°	Standard	Good
Smile CA6738SL	\$270	1024x768	60Hz	20ms	160°	Standard	Poor
Sony CPD-200GS Multiscan	\$580	1024x768	60Hz	20ms	160°	Standard	Excellent
Sony GDM-200PS Multiscan	\$800	1024x768	60Hz	20ms	160°	Standard	Excellent
TechMedia Ventanna 770	\$350	1024x768	60Hz	20ms	160°	Standard	Good
TeleVideo SVP270	\$470	1024x768	60Hz	20ms	160°	Standard	Good
ViewSonic G773	\$480	1024x768	60Hz	20ms	160°	Standard	Good
ViewSonic PT775	\$550	1024x768	60Hz	20ms	160°	Standard	Excellent
19-INCH							
AcerView 99c	\$600	1024x768	60Hz	20ms	160°	Standard	Poor
ADI MicroScan 6P	\$550	1024x768	60Hz	20ms	160°	Standard	Fair
Compaq V90	\$530	1024x768	60Hz	20ms	160°	Standard	Good
Cornerstone c900	\$750	1024x768	60Hz	20ms	160°	Standard	Fair
CTX VL950	\$600	1024x768	60Hz	20ms	160°	Standard	Fair
Dell 1200HS	\$729 (direct)	1024x768	60Hz	20ms	160°	Standard	Fair
EIZO-Nanao FlexScan FX-D7	\$1,000	1024x768	60Hz	20ms	160°	Standard	Good
Gateway VX900	\$520 (direct)	1024x768	60Hz	20ms	160°	Standard	Good
Hansol 900P	\$700	1024x768	60Hz	20ms	160°	Standard	Good
HP M900	\$840	1024x768	60Hz	20ms	160°	Standard	Fair
IBM P92	\$950	1024x768	60Hz	20ms	160°	Standard	Good
 iijama VisionMaster Pro 450	\$700	1024x768	60Hz	20ms	160°	Standard	Good
LG 99T	\$620	1024x768	60Hz	20ms	160°	Standard	Fair
MAG XJ810	\$530	1024x768	60Hz	20ms	160°	Standard	Fair
MaxTech XT-9881	\$480	1024x768	60Hz	20ms	160°	Standard	Poor
Mitsubishi Diamond Scan 90e	\$700	1024x768	60Hz	20ms	160°	Standard	Fair
NEC MultiSync E900+	\$800	1024x768	60Hz	20ms	160°	Standard	Fair
 Nokia 446Xpro	\$799 (list)	1024x768	60Hz	20ms	160°	Standard	Excellent
NSA-Hitachi SuperScan Elite 751	\$780	1024x768	60Hz	20ms	160°	Standard	Good
 Optique V95	\$600	1024x768	60Hz	20ms	160°	Standard	Good
Panasonic PanaSync SL90	\$700	1024x768	60Hz	20ms	160°	Standard	Fair
Philips 109 S	\$700	1024x768	60Hz	20ms	160°	Standard	Good
Pixie 995	\$480	1024x768	60Hz	20ms	160°	Standard	Fair
Princeton AGX900	\$750	1024x768	60Hz	20ms	160°	Standard	Good
Samsung SyncMaster 900p	\$720	1024x768	60Hz	20ms	160°	Standard	Good
Smile CA6929SL	\$620	1024x768	60Hz	20ms	160°	Standard	Poor
Sony GDM-400PS Multiscan	\$860	1024x768	60Hz	20ms	160°	Standard	Good
TeleVideo SVP300	\$650	1024x768	60Hz	20ms	160°	Standard	Good
ViewSonic PS790	\$750	1024x768	60Hz	20ms	160°	Standard	Good

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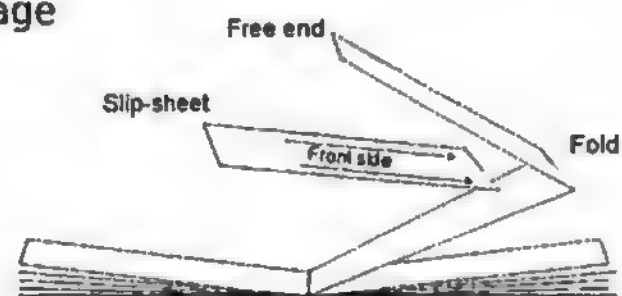


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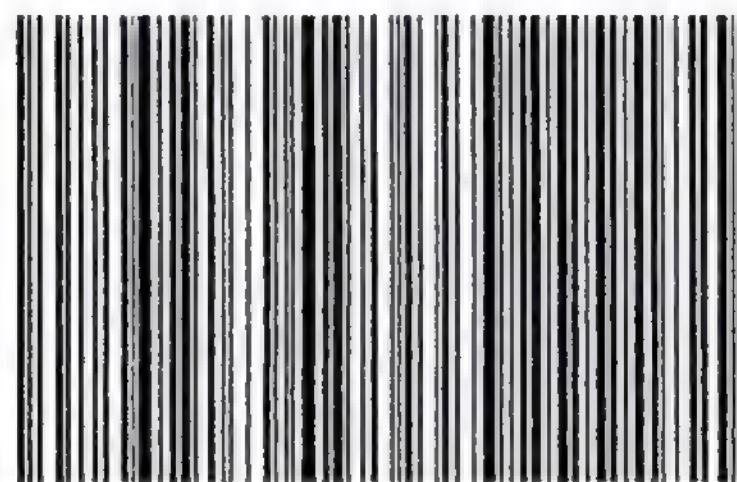
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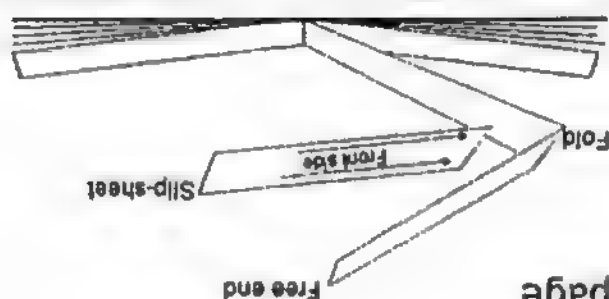
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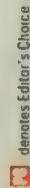
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4. Close the page and slip-sheet



Find the Best Monitor for the Job

Our reviewers rated each monitor's suitability for the most popular chores. See which match your needs.



	Street price	Text editing	Image editing	CAD/CAE
17-INCH				
AcetView 79g	\$450	Good	Excellent	Fair
ADI MicroScan 5P+	\$300	Good	Fair	Fair
Apple Multiple Scan 720	\$499 (list)	Good	Excellent	Good
Compaq V75	\$430	Fair	Excellent	Fair
Compaq P75	\$530	Good	Excellent	Good
CTX PL7+	\$360	Good	Excellent	Good
CTX PR710	\$560	Good	Good	Good
Daewoo 707B	\$260	Fair	Fair	Fair
Dell UltraScan 1000LS	\$429 (direct)	Good	Good	Fair
Dell UltraScan 1000HS	\$629 (direct)	Good	Good	Fair
Eizo Nano FlexScan TX-C7	\$800	Excellent	Excellent	Excellent
Gateway VX700	\$430 (direct)	Excellent	Fair	Good
Hansol 700P	\$400	Excellent	Excellent	Good
HP 70	\$450	Good	Good	Fair
Hyundai DeluxScan 7695B	\$460	Good	Excellent	Fair
IBM G72	\$470	Excellent	Fair	Fair
IBM P72	\$590	Good	Good	Fair
Iiyama VisionMaster Pro 400	\$530	Excellent	Excellent	Good
Impression Vienna Pro 75	\$470	Fair	Good	Poor
KDS AV-7T	\$470	Good	Fair	Fair
LG GoldStar Studioworks 77i	\$300	Good	Good	Good
MAG DJ717	\$330	Good	Fair	Fair
MAG XJ700T	\$330	Good	Good	Fair
MaxTech XT-7861	\$250	Poor	Fair	Poor
Mitsubishi Diamond Pro 87TXM	\$540	Excellent	Excellent	Good
NEC MultiSync A700	\$430	Good	Fair	Fair
NEC MultiSync E700	\$550	Excellent	Excellent	Excellent
Nokia 447XiPlus	\$499 (list)	Excellent	Excellent	Good
NSA-Hitachi SuperScan Elite 641	\$530	Good	Excellent	Fair
Optquest V75	\$420	Excellent	Excellent	Good
Panasonic PanaSync SL70	\$400	Good	Good	Fair
Panasonic PanaFlat PF70	\$680	Excellent	Fair	Good
Philips 107MB	\$430	Excellent	Excellent	Good
Pixie 770	\$250	Good	Fair	Fair
Princeton EO720	\$320	Good	Good	Fair
Princeton EO750	\$400	Good	Good	Good

Is the Future Flat?

There's no doubt that CRT monitors retain the lion's share of the display market, accounting for more than 99 percent of desktop displays sold in 1998. But it's quite possible that display sales may soon go flat—as in flat-panel displays. With the increasing demand for larger displays and higher resolutions, the increased size, weight, and cost of CRTs make them vulnerable to attack.

The most obvious threat is from LCD panels. Initially, these were high-ticket products—\$6,000 for a 15-inch display three years ago—aimed at niche markets where the space savings or cachet could justify paying two or three times the cost of a comparably sized CRT. Now, however, the prices for LCD monitors are plummeting. Major manufacturers including Compaq, NEC, Samsung, Sceptre, and ViewSonic all have LCD monitors in the 14- to 15-inch range that sell for under \$1,000.

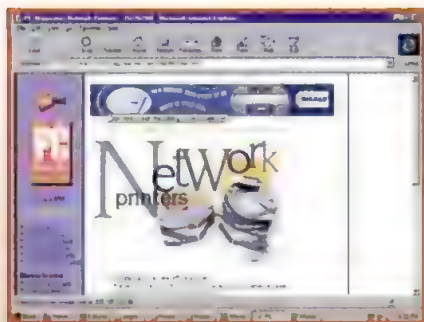
Still, this price is more than twice the average cost of the 17-inch monitors reviewed here. But there are reasons to expect that prices may drop even further. A number of organizations are creating competing digital-interface standards for LCD monitors on the desktop. The most popular right now is PanelLink, which is backed by the Digital Flat Panel Working Group (www.dfpwg.org).



The Flatter the Better
Flat-panel displays, such as this 15-inch Eizo-Nano FlexScan L34, will start appearing on more desktops. Shipment of LCD monitors could hit 1.8 million in 2000.

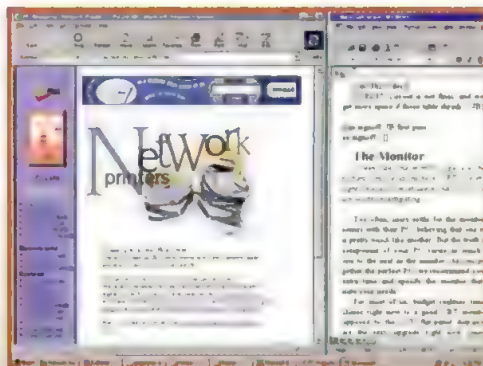
Bigger Screen = More Productivity

A larger monitor gives you more screen real estate, of course, and also lets you view comfortably at a higher resolution. This adds up to more application windows accessible at a glance and more room for large spreadsheets and documents, with less time-wasting scrolling. Here we compare 15-, 17-, 19-, and 21-inch monitors at their optimal resolutions.



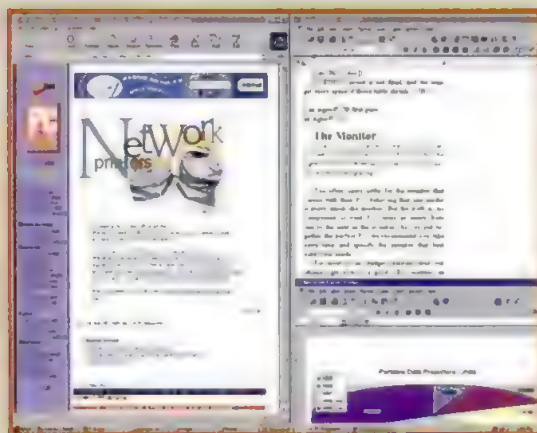
15-inch screen

800-by-600 resolution recommended (shown)
640-by-480 acceptable
1,024-by-768 or higher not recommended



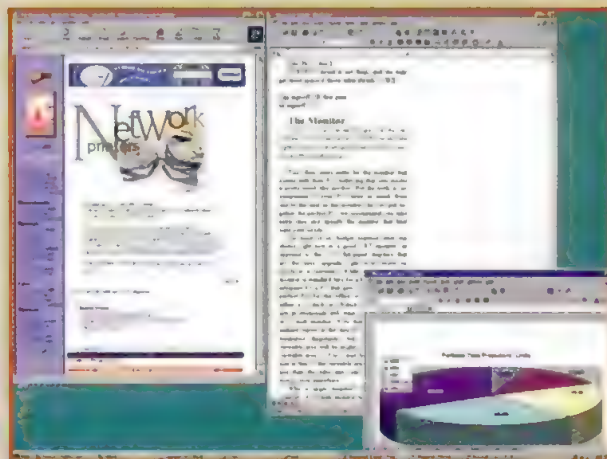
17-inch screen

1,024-by-768 recommended (shown)
800-by-600 acceptable
640-by-480 and 1,280-by-1,024 or higher not recommended



19-inch screen

1,024-by-768 or 1,280-by-1,024 (shown) recommended
800-by-600 acceptable
640-by-480 and 1,600-by-1,200 or higher not recommended



21-inch screen

1,280-by-1,024 or 1,600-by-1,200 (shown) recommended
1,024-by-768 or 1,800-by-1,440 acceptable
800-by-600 or lower not recommended

Deciphering Scan Rate Specs

Monitor makers list some arcane specifications in their literature. To simplify matters, just find the resolution you wish to run in the first column and make sure your monitor supports the minimum vertical refresh rate and horizontal scan rate we cite.

If your desired resolution is...

640-by-480 (VGA)
800-by-600 (SVGA)
1,024-by-768 (XGA)
1,280-by-1,024 (SXGA)
1,600-by-1,200 (UXGA)

...you'll want a vertical refresh rate of at least...

85 Hz
85 Hz
85 Hz
75 Hz
75 Hz

...so the horizontal scan rate needs to be at least...

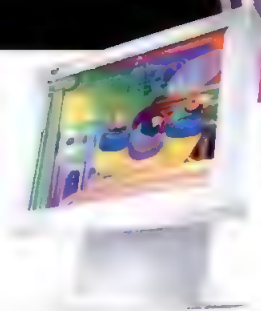
43 kHz
54 kHz
69 kHz
80 kHz
89 kHz

**Are you ready to go
beyond brilliant?**





VP150



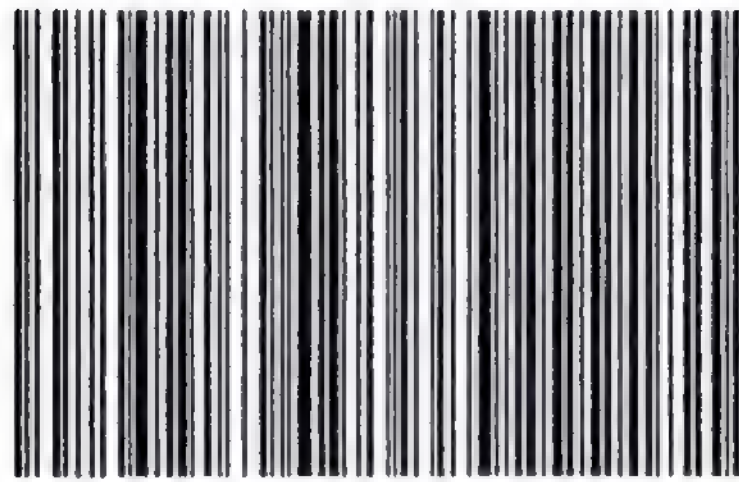
VPA150



ViewSonic
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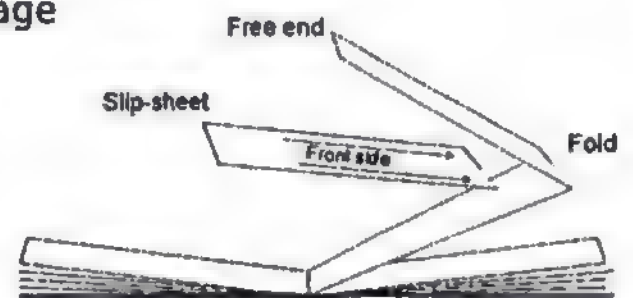
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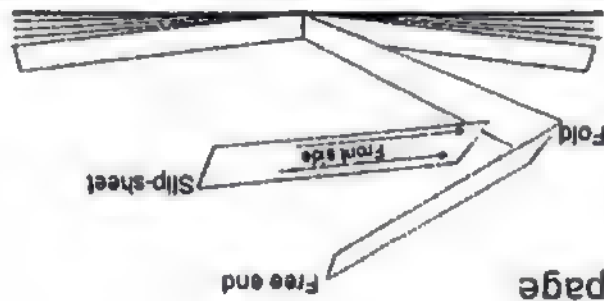
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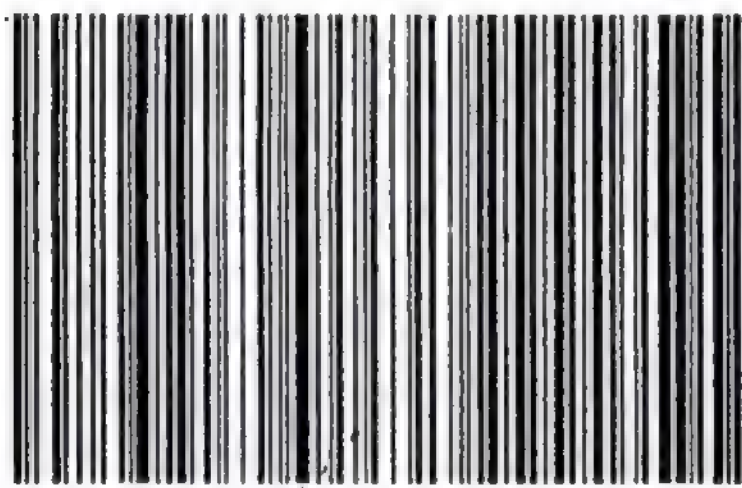
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P817



P815



PS790



ViewSonic
July 1997



PT813
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PT813
June 1997



G810
May 1997



G790
March 1998



WIN 100
1997



COMPUTER
1997



COMPUTER
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July 1998



PT
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P815
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Model	VP150
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Recommended Resolution	1,024 x 768 @ 75Hz
Horizontal Viewing Angle	140°
Brightness (Typical)	250 nits
Contrast Ratio	200:1

Beyond Brilliant.



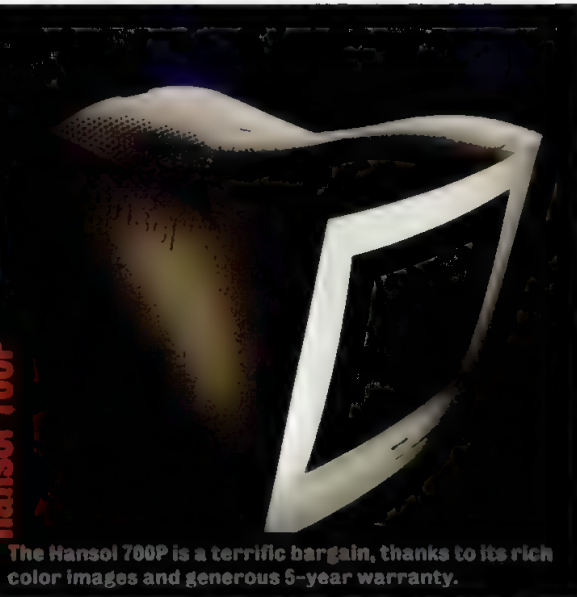
17- and 19-inch Monitors

excellent image regulation and focus, but these strengths were offset by some convergence problems (with no controls to adjust them), strong halo effects, and pronounced moiré patterns that could not be corrected using the controls. User controls rely on three buttons and a rotating disk; they were a bit difficult to use effectively at

whites and crystalline midtones. Tweaking image geometry is a snap, thanks to an effective one-step Auto-Adjustment button that instantly jolts the image into near-perfect alignment. You can upgrade the TX-C7 with a snap-on four-port USB module (\$100 street) or stereo speakers module (\$70 street). The TX-C7 is superior performer.

The 19-inch EIZO-Nanao FlexScan FX-D7 produced similarly competitive results on most of our tests, with a few exceptions. In our labs, the FX-D7 delivered excellent color saturation and shadow detail but was unable to display true black. As a result, otherwise beautiful color output lacked the crispness and snap characteristic of a fully extended tonal range. This monitor's comprehensive control palette includes exotic functions such as four-way moiré reduction, a one-touch Auto-Adjustment button, and the ability to adjust the rela-

tive brightness of different areas of the screen. Though the FX-D7 is an all-around good performer, it doesn't offer the consistent excellence you'd expect from a monitor that sells for more than \$1,000.—*Don Labriola*



The Hansol 700P is a terrific bargain, thanks to its rich color images and generous 5-year warranty.

first, but with some practice, adjustments became fairly quick and easy to make. The 1200HS's affordable price places it in the middle of the pack for 19-inch monitors, making it a reasonable value.—*AP*

EIZO-Nanao FlexScan TX-C7, FX-D7

TX-C7: 17" aperture-grille tube (0.25-mm horizontal mask pitch), 1,280-by-1,024 (85 Hz); \$800 street. **FX-D7:** 19" Invar shadow-mask tube (0.26-mm horizontal dot pitch), 1,600-by-1,200 (76 Hz); \$1,000. Cypress, CA; 800-800-5202, 562-431-5011; www.eizo.com; 509 at www.pcmag.com/infolink.



Both EIZO-Nanao models we tested are standouts in the high-end market and are ideal for graphics and CAD users who need the best image quality. The EIZO-Nanao FlexScan TX-C7 isn't cheap, but its image quality is top-flight. Our jury ranked it second among the 17-inch models in this roundup and it is our Editors' Choice. In our labs, the TX-C7 aced most of our tests, excelling particularly in image stability, registration, and color uniformity. It produced superb results (98 percent) on our Video Bandwidth Index test. Performance was even more impressive when displaying color photographs, with brilliant

Gateway VX700, VX900

VX700: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,280-by-1,024 (75 Hz); \$430 direct. **VX900:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$520. North Sioux City, SD; 800-846-2000, 605-232-2000; www.gateway.com; 510 at www.pcmag.com/infolink.

● These two Gateway monitors provide respectable performance for very reasonable prices. Neither one packs any surprises, but both represent a potential value for standard home and office applications. There's one problem, however: You can buy these monitors only if you're simultaneously purchasing a Gateway computer (or if you've bought one in the past).

Good focus make the Gateway VX700 an excellent choice for work with text. The monitor showed almost no convergence errors, no observable moiré patterns, and an excellent Video Bandwidth Index score. Its digital controls include a continuous

range for color temperature, which may be useful for some graphics arts applications.

The larger Gateway VX900 is priced below some 17-inch units in this roundup. Image quality is mixed, but the 0.22-mm horizontal dot pitch is well-suited to high-resolution images. The monitor showed excellent image regulation and only faint moiré effects that were easily removed with the digital controls. We also noted some convergence problems on our tests. These problems detracted from the monitor's good focus, making it less suitable for text applications than those of some competitors. The affordable price makes the VX900 an attractive choice, but we found that the MaxTech XT-9881 (\$480 street) and Pixie 995 (\$480 street) provide better image quality at similar prices.—*AP*

Hansol 700P, 900P

700P: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$400 street. **900P:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$700. La Palma, CA; 888-426-7651, 714-562-5151; www.hansol-us.com; 511 at www.pcmag.com/infolink.

● The Hansol 700P is marketed for high-end users and specifically for CAD and graphics design; it is one of the best bargains in this roundup. It ranked seventh among 17-inch models on our jury ratings, and indeed our labs testing found focus and color convergence were consistently good, and photo images looked gorgeous. Our testing did reveal minor screen halos, and our gray-scale images appeared a bit brownish. Easy on-screen adjustments of geometry and other display settings plus an usually long five-year warranty make the 700P a recommendable unit for all but the most demanding applications.

The Hansol 900P performed consistently well across all categories, including photo imaging, text, and fine graphics, making it a good choice for general-purpose users. The monitor is also an appropriate but not category-leading choice for its target audience of high-end designers and graphics professionals who sit in front of a tube for more than 6 hours a day. In our labs, we saw very slight focus fuzziness and minimal moiré patterning that could not be fixed with the user controls. Text quality was good in general, though there was minor flickering in the upper-right corner of the screen. Still, the 900P is a good performer for the price.—*BB*



HP 70, HP M900

HP 70: 17" Invar shadow-mask tube (0.28-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$450 street. **HP M900:** 19" Invar shadow-mask tube (0.26-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$840. Palo Alto, CA; 800-322-4772, 970-635-1000; www.hp.com/go/vectra; 512 at www.pcmag.com/infolink.

● Designed for the corporate desktop, these Hewlett-Packard monitors are adequate for most mainstream tasks, though we did find better units. The HP 70 performed on a par with most other 17-inch monitors. It proved a respectable photo-image and text editor on our tests. Images displayed under Photoshop were clear and well-defined. We did notice minor convergence flaws and halos, however. And because its digital brightness controls lack adequate range, we were unable to set the background to a solid black as required for our DisplayMate tests. Optique, Philips, Princeton, and Samsung offer models that we thought performed better at prices close to the HP 70's.

The HP M900 is a better text and image editor than its sibling, but it failed to perform as well on our set of DisplayMate tests. We noticed a few imperfections on our convergence, screen regulation, and halo tests, which means that CAD users will want to look elsewhere. The unit also had difficulty with our Video Bandwidth Index test (scoring a somewhat low 79 percent) and moiré tests (showing patterns in the upper-left-hand corner). There were no problems with the brightness and con-

trast controls; other controls are also effective and easy to use. Both HP monitors are average in most every sense. Though high-end users should look elsewhere, everyday business users will be satisfied.—CM

Hyundai DeluxScan 7695B

17" Invar shadow-mask tube (0.26-mm horizontal dot pitch), 1,280-by-1,024 (85 Hz); \$460 street. San Jose, CA; 800-568-0060, 408-232-8000; www.hca.com; 513 at www.pcmag.com/infolink.

● The midrange Hyundai DeluxScan 7695B is a solid performer that offers a good value to mainstream users.

Capable of more than acceptable performance for business applications, it offers surprisingly good performance on CAD/CAM and line drawing, which is more than we expected at this price. On many of our tests, the 7695B scored well, with solid screen regulation and no visible streaking. Two problems worth mentioning are haloing and a slight lack of crispness at the edges of text characters. One nit we found: The front-panel controls are poorly designed, with a thumbwheel that confusingly moves to the left in order to slide the menu-setting selector to the right. If you can live with that, the Hyundai should make a fine business companion.—MDS

IBM G72, P72, P92

G72: 17" Invar shadow-mask tube (0.28-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$470 street. **P72:** 17" aperture-grille tube (0.25-mm horizontal dot pitch), 1,280-by-1,024 (75 Hz); \$590. **P92:** 19" aperture-grille tube (0.25-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$950. Raleigh, NC; 800-426-2968; www.pc.ibm.com/accessories/monitors; 514 at www.pcmag.com/infolink.

● IBM sells two lines of mainstream monitors: one for business graphics and data entry (the G series), and one for desktop publishing and digital imaging (the P series). The IBM G72 is an excellent text editor with little aptitude for handling detailed color images, and the IBM P72 and P92 units are impressive performers in Photoshop and other graphics applications.

All three are available in either the standard PC off-white or (for around \$20 more) a black case. The one design problem com-

mon to all three units is IBM's one-touch reset button, which sits prominently on the front bezel where it can be easily bumped. This could be a significant irritation if, after carefully calibrating your monitor, you find that you've reset all the controls to their factory defaults with an inadvertent nudge.

Exhibiting near-perfect color registration, respectable video bandwidth, and good focus, the 17-inch G72 is a fine text editor, as our Word and Excel testing showed. Under Photoshop, however, it was less impressive: Images were less than crisp, and colors were generally dull. For text-intensive chores the G72 is a good choice, but you can get a more well-rounded monitor for the price.

The P72 performed well under Photoshop on most photo-image tests, exhibiting excellent color and shading. It was less successful during registration, halo, and regulation tests, proving inadequate for CAD/CAM work. Like the G72, it exhibited noticeable moiré patterns; these were minimized (though not eliminated) by a convenient moiré cancellation control.

The 19-inch P92 landed in second place among the 19-inch candidates during our jury testing, scoring well in Excel, Word, and Photoshop. Because of its excellent sharpness, focus, and registration, the P92 is sufficient even for CAD work. In our labs we noted some moiré problems, but otherwise the unit performed remarkably well. Minor imperfections were visible only during our video bandwidth and streaking tests. Still, this is a fine high-end monitor for the most exacting users.—CM

Iiyama VisionMaster Pro 400, VisionMaster Pro 450

400: 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (90 Hz); \$530 street. **450:** 19" Invar shadow-mask tube (0.26-mm horizontal dot pitch), 1,600-by-1,200 maximum (80 Hz); \$700. Costa Mesa, CA; 800-394-4335, 714-437-5111; www.iiyama.com; 515 at www.pcmag.com/infolink.



The Iiyama VisionMaster monitors we tested are remarkable values. The Iiyama VisionMaster Pro 400 delivers the high performance it promises at a price that nearly qualifies as a bargain. The monitor's high-resolution electronics pay off in quality images suitable for even demanding graphics and

CAD applications. On our tests, text was sharp and highly readable, and photos showed full detail and acceptable colors. The user-control menus offer more options than most, including settings for color temperature, horizontal convergence, and horizontal and vertical moiré. The three-button controls are confusing to use at first, but they're easy enough once you learn them. All in all, this is a high-quality monitor at a reasonable price.

The iiyama VisionMaster Pro 450 delivers a similarly high level of performance and is an Editors' Choice. The monitor is a good choice for everything from business applications to CAD/CAM and graphics, especially for those

Impression Vienna Pro 75

17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (85 Hz); \$470 street. Fremont, CA; 888-532-7878, 510-497-8900; www.impression-brand.com; 516 at www.pcmag.com/infolink.

● The Impression Vienna Pro 75 was not a performance standout on our tests. During application testing, Photoshop images showed sharp contrast, with smooth gradients and deep shadows. But text in Microsoft Word was a bit blurry and had significant echoes, making it hard to read.

We also noticed moiré patterns (which the Pro 75's moiré cancellation feature was unable to eliminate) and a serious color convergence problem between red and blue line segments,

which were more than a full pixel off in many areas. Other problems included significant streaking, major black-level shift, and a minor red/green convergence discontinuity. All told, we preferred other similarly priced models, such as the aperture grille-equipped TeleVideo SVP270 (\$470 street).—JL

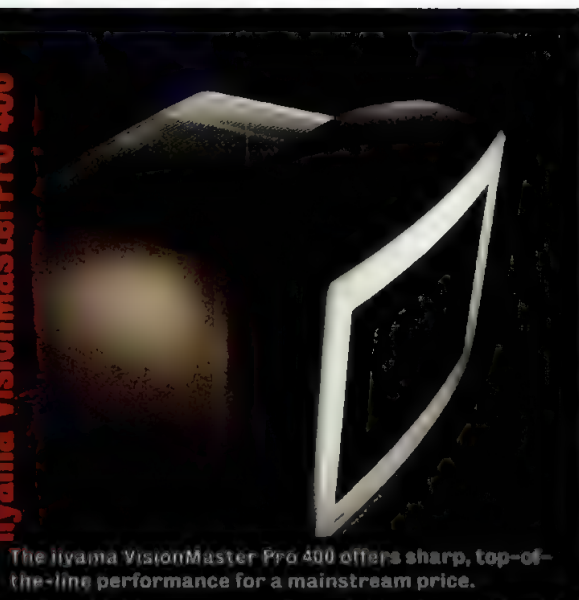
KDS AV-7T

17" aperture-grille tube (0.26-mm stripe pitch), 1,024-by-768 (85 Hz); \$470 street. Garden Grove, CA; 800-237-9988, 714-379-5599; www.kdsusa.com; 517 at www.pcmag.com/infolink.

● The KDS AV-7T was a disappointing performer. Although it has a bargain price for a Trinitron display (and might suit as a home monitor primarily for text applications), image quality is not appropriate for applications involving extended sessions in front of the computer.

In its favor, the AV-7T's focus and Video Bandwidth Index scores were both consistent and very good, making this monitor acceptable for text editing. We saw a variety of image problems on the sample unit in our labs, however. Gray-scale images had a reddish-brown tinge, and our tests turned up problems with red/blue convergence, screen regulation control, haloing, and contrast streaking. The range of more consistent-

iiyama VisionMaster Pro 400



The iiyama VisionMaster Pro 400 offers sharp, top-of-the-line performance for a mainstream price.

who spend a lot of time in front of their systems. Even better, the 450 delivers this high-end performance at a midrange price. On most tests, the 450 did extraordinarily well. Screen regulation was rock-solid, there was no visible streaking, and 7-point text was highly readable. We saw only two problems worth mentioning: obvious halos and a noticeably grayer look to thin vertical white lines. The help-screen menus are essentially identical to those of the 400, with more settings than you'll find in most monitors and controls, that, though confusing at first, are easy enough to master. As with the 400, this is a premium monitor with high-quality output at an invitingly midrange price.—MDS

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color test images, showing brilliant whites, rich blacks, and deeply saturated colors. The unit fared about average on most of our other measurements. Adjusting screen geometry was difficult, and we were unable to eliminate subtle distortions completely. Aggravating these problems are the monitor's limited picture-shaping capabilities and lack of convergence controls. Still, the 99T is worth considering for applications such as photo editing or word processing, though similarly priced models from Optiquest and TeleVideo deliver

The MAG XJ700T, with its precise dial-wheel control, is a reasonable choice for office work.

ly performing monitors from other vendors suggests that you might do better to look elsewhere.—BB

LG GoldStar Studioworks 77i, LG 99T

77i: 17" Invar shadow-mask tube (0.24-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$300 street. **99T:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$620. Englewood Cliffs, NJ; 800-222-6457, 201-816-2000; www.lgeus.com; 518 at www.pcmag.com/infolink.

● LG GoldStar Studioworks 77i provides solid images and intuitive controls at a bargain price. The 77i is one of only four models in this roundup priced at or below \$300. Unlike other lower-priced units we tested, it's a good all-around performer for general-purpose business applications. Image quality was satisfactory; the flaws we noticed during testing included a relatively dim tube that had trouble displaying bright whites and resolving shadow detail. Blacks were solid, but color accuracy was compromised by a slightly greenish cast. None of these are fatal, though, given the price. The 77i boasts smooth, intelligently designed controls that combine digital on-screen menus with easy-to-use analog-style brightness and contrast dials.

The LG 99T does a nice job of displaying photographic images and text. Our test unit suffered from a faint 1.5-inch vertical stripe when displaying full screens of solid color at low brightness levels, but it didn't interfere with our

more even performance.—DL

MAG DJ717, XJ700T, XJ810

DJ717: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$330 street. **XJ700T:** 17" aperture-grille tube (0.25-mm stripe pitch), 1,024-by-768 (85 Hz); \$330. **XJ810:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$530. Irvine, CA; 800-827-3998, 949-855-4930; www.magnovision.com; 519 at www.pcmag.com/infolink.

● This set of monitors provides ample support for general office tasks at very aggressive prices. The MAG XJ700T delivers consistent performance in all areas. Although MAG targets it at professional graphics users, we found some image flaws that suggest it is best suited for more mainstream office tasks. In our labs, the unit showed good focus and screen geometry, and text was sharp. The screen had a slight reddish tinge, however, and we saw minor problems with screen halos and a small bit of red/blue misconvergence on the left side of the screen. This monitor is a decent choice for general users who want an aperture-grille tube at an affordable price.

For the same money you could opt for the MAG DJ717, which employs a shadow-mask tube and delivers higher resolutions and refresh rates. Here again, we found image quality acceptable but not outstanding for the price. Focus was consistently good, and a decent 89 percent result on our Video Bandwidth Index test underscored its



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Pictured above is a Nokia 21" 345Xpro (20" VHS), the industry's first 121kHz monitor with 1800 x 1440 resolution, up to 80Hz refresh rate and .22mm horizontal dot pitch.
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17- and 19-Inch Monitors

Continues

17-INCH MONITORS 19-INCH MONITORS

■ YES ■ NO □ OPTIONAL	AcerView 79g	ADI MicroScan 5P+	Apple Multiple Scan 720	Compaq V75	Compaq P75	CTX PL7+	CTX PR710	Daewoo 707B
Viewable screen size (diagonal, in inches)	16.2	16.0	16.0	16.0	16.0	15.7	16.0	16.2
Price	\$450 street	\$300 street	\$499 list	\$430 street	\$530 street	\$360 street	\$560 street	\$260 street
Tube type	Aperture grille	Shadow mask	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Aperture grille	Shadow mask
CRT manufacturer	Mitsubishi	Hitachi	Info not available	Info not available	Info not available	Hitachi	Sony	Philips
Horizontal dot or stripe pitch (mm)	0.25	0.22	0.28 (diagonal)	0.22 (diagonal)	0.25	0.28 (diagonal)	0.25	0.24
Depth/Weight	16.5 in./43.5 lbs	17.8 in./39.0 lbs	16.9 in./37.5 lbs	17.1 in./44.1 lbs	16.5 in./41.5 lbs	16.0 in./44.0 lbs	17.5 in./41.5 lbs	17.4 in./38.3 lbs
Maximum noninterlaced vertical refresh rate at:								
1,600 x 1,200 / 1,280 x 1,024	75 Hz / 88 Hz	N/A / 60 Hz	N/A / 60 Hz	75 Hz / 60 Hz	N/A / 75 Hz	66 Hz / 66 Hz	66 Hz / 85 Hz	N/A / 65 Hz
1,152 x 870 / 1,024 x 768	85 Hz / 118 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	N/A / 85 Hz	N/A / 85 Hz	N/A / 87 Hz	75 Hz / 110 Hz	65 Hz / 85 Hz
Macintosh-compatible	■	■	■	■	■	■	■	■
Video inputs	VGA, BNC	VGA	VGA	VGA	VGA	VGA, BNC	VGA, BNC	VGA
Monitor can act as USB hub/Number of ports	□ (\$50) / 4	□ (\$100) / 4	□ / N/A	■ / 1	■ / 1	■ / N/A	■ / N/A	□ (\$30) / 4
Multimedia speakers/Watts per channel	□ (\$30) / 3	□ (\$30) / 3	■ / N/A	■ / N/A	Re / N/A	■ / 3	■ / N/A	■ / N/A
Trapezoid/Parallelogram/Pincushion balance	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Tilt/Convergence/Moiré cancellation	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
RGB adjustment/Color temperature	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lockout to prevent changes to settings	■	■	■	■	■	■	■	■
Warranty term (CRT, parts, labor)	3 years	4 years	1 year	3 years	3 years	3 years	3 years	3 years
Quick-exchange program under warranty	None	None	None	2 business days	2 business days	2 business days	2 business days	2 business days
Technical-support hours (eastern time)	24 hours, 7 days	24 hours, 7 days	9:00–9:00 M–F	24 hours, 7 days	24 hours, 7 days	8:30–6:00 M–Th	8:30–6:00 M–Th	9:00–7:00 M–F

N/A—Not applicable. The product does not have this feature.

fine text-editing capability. Moderate moiré patterning and red/blue misconvergence—neither of which could be remedied with user controls—detracted from performance. There were also noticeable local screen-regulation problems and moderate haloing. Colors appeared slightly on the brownish side.

The MAG XJ810 has an appealing price for a 19-inch monitor and offers a great deal for its two target markets: corporate users and PC enthusiasts. But although it's capable of the flicker-free high resolutions that most users seek, the XJ810 not a good choice for engineering applications or graphics professionals because of minor problems in a few test areas. Focus was good in our labs; that, combined with the 86 percent Video Bandwidth Index score, resulted in reasonably sharp and consistent images. moiré patterning in the upper-left-hand corner was noticeable and couldn't be adjusted, and although screen halos and high-contrast streaking were minimal, you could still see them. Color convergence was very good, but in general the colors seemed not as vibrant as those of other 19-inch monitors. Still, the XJ810 is a fine general-purpose monitor at a bargain price.

—BB

MaxTech XT-7861, XT-9881

XT-7861: 17" Invar shadow-mask tube (0.24-mm horizontal dot pitch), 1,024-by-768 (60 Hz); \$250 street. **XT-9881:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$480. Carritos, CA; 800-936-7629, 562-921-1698; www.maxtech.com; 520 at www.pcmag.com/infolink.

● MaxTech's two entries are built to deliver no-frills performance for bargain-basement prices. The company has done a good job hitting this mark with the 19-inch MaxTech XT-9881. In standard business applications, text was highly readable and only a little less crisp than that of some others we tested. Photos had no problems. The only problems we saw during testing were relatively minor: some misconvergence, marginal problems with screen regulation, squashed circles. These issues primarily affect CAD/CAM and line graphics, however. On-screen menu controls for the XT-9881 use the same counterintuitive design as in the Hyundai DeluxScan 7695B: If you move the thumbwheel to the left, the menu selector moves to the right. But this small shortcoming is forgivable in a monitor that offers more than reasonable performance at a notably low price.

Problems in our labs with the 17-inch MaxTech XT-7861 were more pronounced: misconvergence, squashed circles, flawed focus, slight moiré patterns,

streaking, a reddish tint, and highly noticeable problems on the screen regulation and black-level shift tests. In real-world applications, text was readable but not especially crisp. The user-control menus suffer from poor design, forcing you to scroll through all the choices in one direction even when you want to move just one position in the other. If you only have \$250 to spend, you'd do better with the Pixie 770.—MDS

Mitsubishi Diamond Pro 87TXM, Diamond Scan 90e

Diamond Pro 87TXM: 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (85 Hz); \$540 street. **Diamond Scan 90e:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (76 Hz); \$700. Cypress, CA; 800-843-2515, 714-220-2500; www.mitsubishi-display.com; 521 at www.pcmag.com/infolink.

● These latest entries from Mitsubishi are competent performers that will suit most business productivity and image-editing applications. The Mitsubishi Diamond Pro 87TXM is a steal for anyone who needs a high-end model. The monitor was ranked first in image quality by our jury (followed by models from EIZO-Nanao and Sony). In our labs, the monitor sailed through the vast majority of tests without serious problems. In applications testing, it handled text and

SUMMARY OF FEATURES

17- and 19-Inch Monitors



17-INCH MONITORS	19-INCH MONITORS	Dell UltraScan 1000LS	Dell UltraScan 1000HS	EIZO-Nanao FlexScan TX-C7	Gateway VX700	Hansol 700P	HP 70	Hyundai DeluxScan 7695B
■ YES □ NO □ OPTIONAL								
Viewable screen size (diagonal, in inches)		15.9	16.0	15.8	16.0	15.7	15.7	16.0
Price		\$429 direct	\$629 direct	\$800 street	\$430 direct	\$400 street	\$450 street	\$460 street
Tube type		Shadow mask	Aperture grille	Aperture grille	Aperture grille	Shadow mask	Shadow mask	Shadow mask
CRT manufacturer		Philips	Sony	Mitsubishi	Mitsubishi	Samsung	Info not available	Hitachi
Horizontal dot or stripe pitch (mm)		0.28 (diagonal)	0.25	0.25	0.25	0.22	0.28	0.26
Depth/Weight		17.7 in./40.7 lbs	16.5 in./44.0 lbs	17.3 in./46.4 lbs	16.7 in./48.0 lbs	21.8 in./48.8 lbs	16.8 in./37.5 lbs	17.6 in./38.1 lbs
Maximum noninterlaced vertical refresh rate at:								
1,600 x 1,200 / 1,280 x 1,024		N/A / 64 Hz	65 Hz / 75 Hz	73 Hz / 85 Hz	66 Hz / 75 Hz	66 Hz / 85 Hz	N/A / 64 Hz	75 Hz / 85 Hz
1,152 x 870 / 1,024 x 768		75 Hz / 85 Hz	92 Hz / 105 Hz	100 Hz / 113 Hz	93 Hz / 106 Hz	75 Hz / 85 Hz	N/A / 85 Hz	75 Hz / 75 Hz
Macintosh-compatible		■	■	■	■	■	■	■
Video inputs		VGA	VGA	VGA, BNC	VGA	VGA	VGA	VGA, BNC
Monitor can act as USB hub/Number of ports		■ / N/A	■ / N/A	□ (\$159) / 4	■ / N/A	■ / N/A	■ / N/A	■ / 1
Multimedia speakers/Watts per channel		■ / N/A	■ / N/A	□ (\$69) / 2	■ / N/A	■ / N/A	■ / N/A	■ / N/A
Trapezoid/Parallelogram/Pincushion balance		■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Tilt/Convergence/Moiré cancellation		■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
RGB adjustment/Color temperature		■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Lockout to prevent changes to settings		■	■	■	■	■	■	■
Warranty term (CRT, parts, labor)		1 year	1 year	3 years	3 years	5 years (CRT, 3 years)	3 years	3 years
Quick-exchange program under warranty		1 business day	1 business day	None	4 business days	2 business days	1 business day	None
Technical-support hours (eastern time)		24 hours, 7 days	24 hours, 7 days	8:00-5:00 M-F	24 hours, 7 days	11:00-10:00 M-F	9:00-8:00 M-F	11:00-8:00 M-F

N/A—Not applicable. The product does not have this feature.

photos without flaw. User help menus offer a number of sophisticated settings, such as horizontal and vertical convergence, and the controls are notably easy to learn and use. By any measure, the 87TXM is a high-quality monitor, suitable for demanding tasks and for users who spend long sessions staring at a monitor screen.

Its 19-inch cousin, the Mitsubishi Diamond Scan 90e, offers midrange performance that's more than acceptable for most applications. But it's no match for some other competitors in its price range, such as the Compaq V90 (\$530 street) or the Philips 109 S (\$700 street). The 90e showed no major flaws on our tests but suffered from a large number of minor problems, including slightly squashed circles in some areas of the screen, a soft-focus effect on our focus tests, and halos. Seven-point text was readable but not as crisp as on some other monitors. It handled photos without problems. Menus and adjustment screens are essentially identical to those of the Diamond Pro 87TXM, with a number of sophisticated settings and easy-to-use controls. There's also an optional USB hub upgrade (\$79) for the 90e.—MDS

NEC MultiSync A700, E700, E900+

A700: 17" Invar shadow-mask tube (0.24-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$430 street. **E700:** 17" slot-mask tube (0.25-mm mask pitch), 1,024-by-768 (85 Hz); \$550.

E900+: 19" Invar shadow-mask tube (0.23-mm horizontal dot pitch), 1,600-by-1,200 (77 Hz); \$800. Itasca, IL; 800-632-4636, 630-467-5000; www.nec.com; 522 at www.pcmag.com/infolink.



These NEC offerings are proficient at typical office work. The NEC Multi-Sync E700's image quality makes it right even for demanding graphics and CAD users—winning it an Editors' Choice. One feature we especially liked across the board was the optional tilt/swivel bases that are available for all three models (and that also fit previous NEC monitors). These let you upgrade to a four-port USB hub (\$79 list), multimedia speaker system from Altec Lansing (\$79 list), or both (\$129 list) when you're ready, without having to buy a whole new monitor.

The E700, based on NEC's own ChromaClear slot-mask tube, stands out as a fine performer in this roundup, with crisp, brilliant images at a solid

midrange price. Our reviewers and jury panel judged it to be among the best 17-inch models we saw. Unlike the first-generation ChromaClear tube, this enhanced iteration created good contrast and colorful images. The E700 had nearly perfect convergence and an excellent Video Bandwidth Index score, contributing to a crisp display of fine details and making it an excellent choice for text applications. Screen geometry was uniform across the entire image. This is an excellent choice for most applications.

The NEC MultiSync A700 is part of NEC's value line, intended for everyday home and office use. Thanks to its good convergence, the monitor proved fine on our text-based tests, but other flaws detracted from its appeal. The A700 is not well-suited for graphics work, because the black level changes with image content and there are only two color temperature settings (9,300° and 7,500°). The image showed only faint moiré patterns, but there were no controls to adjust them, and images lacked detail in lighter and darker shades. Screen geometry was only fair. If

IBM G72	IBM P72	Iiyama VisionMaster Pro 400	Impression Vienna Pro 75	KDS AV-7T	LG GoldStar Studioworks 77i	MAG DJ717	MAG XJ700T	MaxTech XT-7861	Mitsubishi Diamond Pro 87TXM
15.7	16.0	16.0	16.1	16.0	15.9	16.2	16.0	16.1	16.0
\$470 street	\$590 street	\$530 street	\$470 street	\$470 street	\$300 street	\$330 street	\$330 street	\$250 street	\$540 street
Shadow mask	Aperture grille	Aperture grille	Aperture grille	Aperture grille	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Shadow mask
Philips	Sony	Mitsubishi	Mitsubishi	Sony	LG Electronics	Hitachi	Sony	LG Electronics	Mitsubishi
0.28	0.25	0.25	0.25	0.25	0.28 (diagonal)	0.22	0.25	0.28	0.25
16.8 in./38.5 lbs	17.1 in./43.0 lbs	16.5 in./46.0 lbs	17.1 in./40.7 lbs	17.7 in./34.8 lbs	17.0 in./41.1 lbs	17.1 in./38.6 lbs	17.0 in./40.5 lbs	16.8 in./47.4 lbs	16.7 in./48.4 lbs
N/A / N/A	N/A / 75 Hz	77 Hz / 90 Hz	75 Hz / 85 Hz	N/A / 60 Hz	N/A / 65 Hz	69 Hz / 80 Hz	N/A / 66 Hz	N/A / 60 Hz	66 Hz / 79 Hz
N/A / 85 Hz	N/A / 85 Hz	105 Hz / 110 Hz	85 Hz / 85 Hz	75 Hz / 85 Hz	76 Hz / 87 Hz	94 Hz / 106 Hz	77 Hz / 86 Hz	75 Hz / 85 Hz	93 Hz / 106 Hz
VGA	VGA	VGA, BNC	VGA	VGA	VGA	VGA	VGA	VGA	VGA, BNC
□ (\$49) / 4	□ (\$49) / 4	□ (\$100) / 4	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A
□ (\$35) / 3	□ (\$35) / 3	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A	□ / N/A
■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■
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■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■
3 years	3 years	3 years	5 years (CRT, 3 years)	3 years	3 years	3 years	3 years	3 years	3 years
2 business days	2 business days	2 business days	2 business days	3 business days	None	2 business days	2 business days	None	2 business days
24 hours, 7 days	24 hours, 7 days	8:00–8:00 M–F	24 hours, 7 days	8:30–5:30 M–Th, 8:00–4:30 F	24 hours, 7 days	11:00–8:00 M–F	11:00–8:00 M–F	Midnight–9:00 P.M. M–F	8:00–8:00 M–F, noon–8:00 Sat., Sun

you just need a monitor for text editing and are more comfortable with the NEC name, the A700 will suffice, but you can find better performance for the money from Optquest, Princeton, and Samsung.

Similarly, the NEC MultiSync E900+ didn't fare as well as some of the like-priced competition from Compaq, Iiyama, and others. The 0.23-mm horizontal dot pitch is certainly capable of handling high-resolution images. Focus was crisp on our tests; and the screen regulation test was rock-solid. But during our testing we noticed convergence problems that couldn't be corrected using the on-screen controls, and the Video Bandwidth Index score was only fair, rendering the monitor about average for text applications despite its excellent focus. There was also a hook effect in one corner that could not be straightened, even with all the sophisticated screen geometry controls. Also, the proportions in some areas of the display were slightly distorted. Because of these limitations, the E900+ would be better for photo image editing and text applications than for CAD/CAM work.—AP

Nokia 447XiPlus, 446Xpro

447XiPlus: 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (80 Hz); \$499 list. **446Xpro:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (85 Hz); \$799. Sausalito, CA; 800-296-8542, 415-331-4244; www.nokia/americas.com; 523 at www.pcmag.com/infolink.



Nokia's monitors deliver outstanding performance for business users who don't mind paying a little extra for the luxury. The 17-inch Nokia 447XiPlus was one of our jury finalists (placing fourth), and it delivered near-perfect performance in our labs. The screen geometry and other image controls are extremely easy to use, and there were no moiré or color convergence problems to speak of. Focus was consistently good. With a fine 90 percent Video Bandwidth Index score and good control of colors and contrast, users will find this monitor a pleasure to use for general business text and data entry as well as for image editing.

The 19-inch Nokia 446Xpro—an Editors' Choice—is aimed squarely at graphics designers and imaging professionals, and here, too, the monitor delivers out-

standing performance for the price. We saw no significant moiré, convergence, or screen regulation problems on our tests, and the unit delivered a Video Bandwidth Index score of 94 percent—among the best we tested. With its tight, consistent focus, right-on color, and very minimal screen haloing, the 446Xpro is a fine choice for any application, particularly for users who need the highest levels of performance.—BB

NSA-Hitachi SuperScan Elite 641, SuperScan Elite 751

641: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,280-by-1,024 (87 Hz); \$530 street. **751:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$780. Westwood, MA; 800-441-4832, 781-461-8300; www.nsa-hitachi.com; 524 at www.pcmag.com/infolink.

● NSA-Hitachi was the first to deliver a 19-inch monitor to the U.S. market last year. Its close relationship with Hitachi, the CRT maker, certainly helped—though the two are separate companies. This year's NSA-Hitachi SuperScan Elite 751 is one of the best. It was ranked first among 19-inch models by our jury. We found it notable for highly readable

SUMMARY OF FEATURES

17- and 19-Inch Monitors



17-INCH MONITORS 19-INCH MONITORS

■ YES ■ NO □ OPTIONAL

	NEC MultiSync A700	NEC MultiSync E700	Nokia 447XiPlus	NSA-Hitachi SuperScan Elite 641	Optquest V75	Panasonic PanaSync SL70	Panasonic PanaFlat PF70
Viewable screen size (diagonal, in inches)	15.6	15.6	15.8	15.9	16.0	16.0	16.0
Price	\$430 street	\$550 street	\$499 list	\$530 street	\$420 street	\$400 street	\$680 street
Tube type	Shadow mask	Slot mask	Aperture grille	Shadow mask	Shadow mask	Shadow mask	Flat tension mask
CRT manufacturer	NEC	NEC	Sony	Hitachi	Hitachi	Matsushita	Matsushita
Horizontal dot or stripe pitch (mm)	0.24	0.25	0.25	0.22	0.22	0.23	0.24
Depth/Weight	17.3 in./40.8 lbs	17.8 in./43.0 lbs	17.2 in./41.8 lbs	16.3 in./37.4 lbs	17.1 in./38.6 lbs	15.0 in./37.4 lbs	17.1 in./41.7 lbs
Maximum noninterlaced vertical refresh rate at:							
1,600 x 1,200 / 1,280 x 1,024	N/A / 65 Hz	65 Hz / 76 Hz	N/A / 80 Hz	75 Hz / 87 Hz	77 Hz / 89 Hz	N/A / 66 Hz	69 Hz / 81 Hz
1,152 x 870 / 1,024 x 768	75 Hz / 85 Hz	89 Hz / 102 Hz	90 Hz / 105 Hz	N/A / 115 Hz	103 Hz / 117 Hz	77 Hz / 87 Hz	94 Hz / 106 Hz
Macintosh-compatible	■	■	■	■	■	■	■
Video inputs	VGA	VGA	VGA	VGA	VGA	VGA	VGA, BNC
Monitor can act as USB hub/Number of ports	□ (\$79) / 4	□ (\$79) / 4	/ N/A	/ N/A	/ N/A	□ (\$53) / 4	□ (\$53) / 4
Multimedia speakers/Watts per channel	/ N/A	/ N/A	/ N/A	/ N/A	/ N/A	/ N/A	1w / N/A
Trapezoid/Parallelogram/Pincushion balance	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Tilt/Convergence/Moiré cancellation	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
RGB adjustment/Color temperature	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lockout to prevent changes to settings	■	■	■	■	■	■	■
Warranty term (CRT, parts, labor)	3 years	3 years	3 years	3 years	3 years	3 years	3 years
Quick-exchange program under warranty	1 business day	1 business day	3 business days	None	None	2 business days	2 business days
Technical-support hours (eastern time)	8:00 A.M. - 8:30 P.M. M-F	8:00 A.M. - 8:30 P.M. M-F	8:00-8:00 M-F	8:30-8:00 M-F	10:00-9:00 M-F	24 hours, 7 days	24 hours, 7 days

N/A—Not applicable. The product does not have this feature.

text with crisp edges. The high-quality performance we saw on our test screens carried through to real-world applications. The front panel offers about a dozen clearly marked control buttons that ease the task of adjusting geometry, color, brightness, contrast, and more. The 751 delivers good performance for the price on everything from mainstream business applications to CAD and graphics.

The NSA-Hitachi SuperScan Elite 641 is targeted at graphics users, but it delivers merely standard functionality for mainstream business and home use. The four-button menu controls are straightforward and easy to learn, and the menus offer a suitably rich collection of settings. In focus-related testing, edges were less crisp than they should have been, both on test screens and in real-world applications. We also saw streaking, halos, bright edges on thin black lines (which can affect text), and less-than-ideal screen regulation. All of these flaws will adversely affect CAD/CAM and graphics screens. You can find 17-inch monitors from iiyama, Mitsubishi, NEC, and other manufacturers that deliver better performance for the money.—MDS

Optquest V75, V95

V75: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,280-by-1,024 (89 Hz); \$420 street. **V95:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,280 (76 Hz); \$600. Walnut, CA; 800-843-6784, 909-869-9216; www.optquest.com; 525 at www.pcmag.com/infolink.



Optquest bills its monitors as consistent performers for reasonable prices, and the excellent Optquest V75 and V95 bear this out. Both are among the best in their respective size classes and perform handily in a wide variety of applications.

Targeted for the SOHO market, the V75 is especially well suited for image and text editing, though it also makes a strong showing on high-end graphics tests as well. Focus and contrast were consistently good on our tests, though gray-scale testing showed a minor brownish tinge. Contrast was good, and power regulation was solid. Such good performance and a moderate price make this a recommendable unit for any PC user.

The V95 delivered similarly fine performance and is an Editor's Choice. We saw no moiré patterning, and screen colors were right on the mark (though we did see some screen haloing). Our jury ranked it

seventh among the 19-inch models we tested. This is an inexpensive choice for home and small-business users, who will find it well suited for image and text editing.—BB

PanaSync SL70, Panasonic PanaFlat PF70, PanaSync SL90

PanaSync SL70: 17" Invar shadow-mask tube (0.23-mm horizontal dot pitch), 1,024-by-768 (87 Hz); \$400 street. **PanaFlat PF70:** 17" PureFlat stripe-mask tube (0.24-mm stripe pitch), 1,280-by-1,024 (81 Hz); \$680. **PanaSync SL90:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,280-by-1,024 (88 Hz); \$700. Secaucus, NJ; 800-742-8086, 201-392-4812; www.panasonic.com/alive; 526 at www.pcmag.com/infolink.

● From truly flat screens to short-neck tubes, Panasonic offers class-leading features in each of these three monitors. This doesn't translate into perfect performance, however. Although all have their strong points, and the Panasonic PanaSync SL70 is a particularly good budget choice, none is outstanding.

When it comes to innovation, the Panasonic PanaFlat PF70 still stands alone: The monitor is the only 17-inch CRT with a face that's flat both vertically and horizontally. This feature gives it a deep, reflection-free image normally associated with LCD screens. Unfortunately, though the price is correspondingly near the top of its class, the

Philips 107MB	Pixie 770	Princeton E0720	Princeton E0750	Proton MM-750i	Samsung SyncMaster 700b	Samsung SyncMaster 700p Plus	Shamrock C709 M5	Smile CA6738SL	Sony CPD-200GS Multiscan
15.9	15.8	16.0	16.0	15.9	15.7	16.0	16.0	16.0	16.0
\$430 street	\$250 street	\$320 street	\$400 street	\$400 street	\$380 street	\$450 street	\$430 street	\$270 street	\$580 street
Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Aperture grille
Hitachi	Hitachi/LG	Toshiba	Hitachi	LG Electronics	Samsung	Samsung	Mitsubishi	Hitachi	Sony
0.22	0.28	0.23	0.23	0.23	0.24	0.26	0.22	0.28	0.25
18.4 in./40.0 lbs	21.5 in./38.5 lbs	17.7 in./34.8 lbs	17.7 in./39.9 lbs	16.8 in./40.9 lbs	17.6 in./41.9 lbs	17.5 in./41.0 lbs	16.8 in./37.4 lbs	16.5 in./38.5 lbs	16.5 in./39.7 lbs
65 Hz / 80 Hz	N/A / 65 Hz	N/A / 66 Hz	76 Hz / 88 Hz	N/A / 65 Hz	N/A / 60 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	65 Hz / 75 Hz	N/A / 75 Hz
N/A / 85 Hz	75 Hz / 85 Hz	76 Hz / 86 Hz	104 Hz / 116 Hz	76 Hz / 86 Hz	N/A / 85 Hz	75 Hz / 85 Hz	105 Hz / 115 Hz	75 Hz / 85 Hz	N/A / 85 Hz
■	■	■	■	■	■	■	■	■	■
VGA	VGA	VGA, D-sub mini	VGA, D-sub mini	VGA	VGA	VGA, BNC	VGA	VGA	VGA, D-sub mini
■ / N/A	■ / N/A	■ / N/A	■ / 2	■ / N/A	■ / N/A	■ / N/A	□ (\$50) / 4	■ / N/A	■ / N/A
■ / 2	□ (\$50) / 15	■ / N/A	■ / N/A	■ / 11	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / 1
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years (CRT, 1 year)	3 years	3 years
2 business days	3 business days	2 business days	2 business days	None	2 business days	2 business days	None	None	2 business days
8:00–8:00 M–F	11:30–8:30 M–F	24 hours, 7 days	24 hours, 7 days	8:00–5:00 M–F	24 hours, 7 days	24 hours, 7 days	8:00–5:00 M–F	8:30–5:30 M–F	24 hours, 7 days

image quality is short of premium. In our labs, the digital controls were effective at removing moiré effects, and the monitor scored high on our bandwidth index test and should prove fine for text applications. Convergence and screen regulation tests also produced good results. But there was some pincushioning that could not be eliminated. We also had difficulty in getting dark shades of gray visible without raising the black level; as a result, the PF70 did not do a good job with highlights and shadows on photographic images.

Both Panasonic PanaSync SL70 and SL90 units use the new wide-deflection yoke, which makes their cases much shorter. The SL70 is only 15 inches deep, and the SL90 is just 16.3 inches deep—in both cases, less than most 17-inch monitors in this roundup. The SL70 showed fine color performance, a good score on the bandwidth index, good screen geometry, and steady screen regulation. The image had some small flaws, including some small convergence errors (there are no convergence adjustment controls), moderate haloing, and one corner area that was slightly out of focus, making the unit good but not outstanding for text use. The SL70 is a fine value for general-purpose applications.

The SL90 has an attractive price, but image-quality flaws detract from its appeal. Although it had excellent image registration, no moiré effects, and good convergence, the bandwidth index was only fair; the image proportions were off, and the screen showed strong halo and horizontal streaking effects. The SL90 is an acceptable performer, but we feel you can do better with the similarly priced 19-inch models here from iiyama or Philips.—AP

Philips 107MB, 109 S

107MB: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$430 street. **109 S:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,280 (75 Hz); \$700. Atlanta; 800-835-3506; 423-475-0280; www.philipsmonitors.com; 527 at www.pcmag.com/infolink.

● The latest monitors from Philips are noteworthy entries that deliver fine performance. Targeted at both corporate and SOHO markets, the Philips 107MB includes a built-in microphone and stereo speakers that provide adequate sound for videoconferencing. The monitor is also a consistently good performer. There were no visible moiré patterning or convergence problems on our tests, and focus and regulation controls were excellent, making the monitor suitable for text-

based applications. Color was particularly good. In our labs, the only flaw we found was some quite noticeable screen haloing. For both text and image editing, the 107MB is a great deal.

The 19-inch Philips 109 S is another good buy. With a competitive price, good performance—particularly for text editing—and a screen-control lockout feature to prevent busy fingers from throwing the settings off, the 109 S is a strong candidate for home users. Screen focus, geometry, and color were fine, and the 109 S's 94 percent Video Bandwidth Index score was excellent, suggesting that this monitor is a good choice for long document-editing sessions and for work with photo images and graphics. During testing, we saw some slight upper-left-hand corner moiré patterning, which was somewhat adjustable with the user controls, and minor red/blue misconvergence. Minimal screen halos and high-contrast streaking were also evident. But for typical home and office applications, the 109 S is a fine choice.—BB

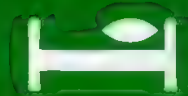
Pixie 770, 995

770: 17" Invar shadow-mask tube (0.24-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$250 street. **995:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-

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SUMMARY OF FEATURES

17- and 19-Inch Monitors

17-INCH MONITORS 19-INCH MONITORS

■ YES □ NO □ OPTIONAL

	Sony GDM-200PS Multiscan	TechMedia Ventanna 770	TeleVideo SVP270	ViewSonic G773	ViewSonic PT775	AcerView 99c	ADI MicroScan 6P
Viewable screen size (diagonal, in inches)	16.0	15.7	15.8	16.0	16.0	18.0	18.0
Price	\$800 street	\$350 street	\$470 street	\$480 street	\$550 street	\$600 street	\$550 street
Tube type	Aperture grille	Shadow mask	Aperture grille	Shadow mask	Aperture grille	Shadow mask	Shadow mask
CRT manufacturer	Sony	Samsung	Mitsubishi	Toshiba	Mitsubishi	Hitachi	Hitachi
Horizontal dot or stripe pitch (mm)	0.25	0.28	0.25	0.22	0.25	0.22	0.22
Depth/Weight	16.5 in./43.0 lbs	16.5 in./46.9 lbs	18.0 in./46.0 lbs	17.3 in./38.5 lbs	18.0 in./46.2 lbs	19.1 in./55.0 lbs	18.4 in./41.8 lbs
Maximum noninterlaced vertical refresh rate at: 1,600 x 1,200 / 1,280 x 1,024	70 Hz / 85 Hz	N/A / 60 Hz	75 Hz / 90 Hz	N/A / 66 Hz	77 Hz / 89 Hz	75 Hz / 88 Hz	75 Hz / 85 Hz
1,152 x 870 / 1,024 x 768	75 Hz / 85 Hz	N/A / 80 Hz	105 Hz / 119 Hz	75 Hz / 87 Hz	103 Hz / 117 Hz	85 Hz / 117 Hz	85 Hz / 100 Hz
Macintosh-compatible	■	■	■	■	■	■	■
Video inputs	VGA, BNC, D-sub mini	VGA	VGA, BNC	VGA	VGA, BNC	VGA, BNC	VGA
Monitor can act as USB hub/Number of ports	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / 4	□ (150) / 4	■ / 4
Multimedia speakers/Watts per channel	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A	□ (30) / 3	□ (30) / 3
Trapezoid/Parallelogram/Pincushion balance	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Tilt/Convergence/Moiré cancellation	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
RGB adjustment/Color temperature	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Lockout to prevent changes to settings	■	■	■	■	■	■	■
Warranty term (CRT, parts, labor)	3 years	3 years	3 years	3 years	3 years	3 years	4 years
Quick-exchange program under warranty	2 business days	None	3 business days	None	None	None	None
Technical-support hours (eastern time)	24 hours, 7 days	11:00 P.M.-3:00 A.M., 7 days	8:00-6:00 M-F	10:00-9:00 M-F	10:00-9:00 M-F	24 hours, 7 days	24 hours, 7 days

N/A—Not applicable. The product does not have this feature.

by-1,200 (75 Hz); \$480. Fremont, CA; 800-440-7211, 510-440-9721; www.pixie.com; 528 at www.pcmag.com/infolink.

● The news here is price: These entries from Pixie are among the lowest-priced in their classes. The Pixie 770 is targeted specifically at budget-oriented users. Merely a fair performer for both image and line graphics editing, the monitor is most appropriate for text and for only occasional use with other applications. The focus and geometry controls were generally good, though colors appeared somewhat brownish, and screen halos and localized regulation problems showed the monitor's limitations. But at this price, the 770 is a good deal for casual, general use.

The 19-inch Pixie 995 is designed for SOHO graphics users and is a suitable choice for that purpose, with consistently good observed performance in line graphics applications. Focus was very good, but the relatively low 75 percent score on the Video Bandwidth Index test suggests that long-term text-editing sessions might be somewhat tiring because of grayness. Photos looked very good, with clear, crisp colors. We did notice some minor red/blue misconvergence and pronounced screen haloing, however, so engineers will want to look

elsewhere. Still, the Pixie 995 is a solid value.—BB

Princeton EO720, EO750, AGX900

EO720: 17" Invar shadow-mask tube (0.23-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$320 street. **EO750:** 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,280-by-1,024 (85 Hz); \$400. **AGX900:** 19" aperture-grille tube (0.22-mm horizontal stripe pitch), 1,600-by-1,200 (76 Hz); \$750. Santa Ana, CA; 800-727-6249, 714-751-8405; www.pgr.com; 529 at www.pcmag.com/infolink.

● These monitors from Princeton offer reasonable image quality at affordable prices. They are adequate candidates for use as standard office workhorses, and the Princeton AGX900 is particularly adept for text-intensive work.

The Princeton EO720 has no major flaws and ought to provide acceptable performance for less-demanding applications such as word processing or Web surfing. Its unusually bright tube seemed a bit overdriven in our labs, producing brilliant whites but slightly washed-out color. The monitor did well in areas such as resolution, focus, registration, text legibility, and freedom from artifacts. We were never able to align the EO720's screen geometry perfectly, however, despite the monitor's one-touch Auto-Setup button and Corner Pincushion con-

trol. Still, the unit is not a bad choice for general-purpose computing.

The Princeton EO750 is a state-of-the-art monitor with full USB support, a one-touch automatic screen setup button, and claimed support for 1,600-by-1,200 resolution. The EO750 doesn't rival the picture quality of the best units in this roundup, but it's a good choice if you're looking for a mid-priced monitor with a built-in four-port powered USB hub. Notably, you can also use USB to navigate through the on-screen menus with a mouse. Registration and geometry were solid in our labs, and the effective Auto-Setup function helped compensate for a lack of convergence controls. The tube's color output was generally good but suffered from a subtly greenish tint, dingy whites, and compressed shadow detail. In general, this monitor would be a contender in most mainstream environments but is most attractive for its USB features.

The AGX900 is a good choice for text-oriented applications and acceptable for image-editing work. It produced superb results on tests that measured registration, focus, color accuracy, freedom from artifacts, video bandwidth, and geometric precision. Its elegant three-button inter-

SUMMARY OF FEATURES

17- and 19-Inch Monitors

17-INCH MONITORS 19-INCH MONITORS

■ YES ■ NO □ OPTIONAL

	LG 99T	MAG XJ810	MaxTech XT-9881	Mitsubishi Diamond Scan 90e	NEC MultiSync E900+	Nokia 446Xpro	NSA-Hitachi SuperScan Elite 751
Viewable screen size (diagonal, in inches)	18.0	18.0	18.0	18.0	18.0	17.7	18.0
Price	\$620 street	\$530 street	\$480 street	\$700 street	\$800 street	\$799 list	\$780 street
Tube type	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask
CRT manufacturer	Hitachi	Hitachi	Hitachi	Mitsubishi	Toshiba	Hitachi	Hitachi
Horizontal dot or stripe pitch (mm)	0.23	0.22	0.26	0.25	0.23	0.21	0.22
Depth/Weight	18.9 in / 53.5 lbs	18.3 in / 46.3 lbs	18.7 in / 52.5 lbs	16.1 in / 49.5 lbs	18.9 in / 52.5 lbs	18.6 in / 50.6 lbs	18.1 in / 55.0 lbs
Maximum noninterlaced vertical refresh rate at 1,600 x 1,200 / 1,280 x 1,024 1,152 x 870 / 1,024 x 768	75 Hz / 85 Hz 105 Hz / 115 Hz	75 Hz / 88 Hz 103 Hz / 116 Hz	75 Hz / 60 Hz 75 Hz / 85 Hz	76 Hz / 86 Hz 106 Hz / 120 Hz	76 Hz / 89 Hz 104 Hz / 119 Hz	85 Hz / 99 Hz 115 Hz / 130 Hz	75 Hz / 85 Hz N/A / 115 Hz
Macintosh-compatible	■	■	■	■	■	■	■
Video inputs	VGA, BNC	VGA	VGA	VGA, BNC	VGA	VGA, BNC	VGA
Monitor can act as USB hub/Number of ports	■ / N/A	■ / 4	■ / N/A	■ / 4	□ (\$79) / 4	■ / N/A	■ / N/A
Multimedia speakers/Watts per channel	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A
Trapezoid/Parallelogram/Pincushion balance	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Tilt/Convergence/Moiré cancellation	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
RGB adjustment/Color temperature	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lockout to prevent changes to settings	■	■	■	■	■	■	■
Warranty term (CRT, parts, labor)	5 years (CRT, 3 years)	3 years	3 years	3 years	3 years	3 years	3 years
Quick-exchange program under warranty	2 business days	2 business days	None	2 business days	1 business day	3 business days	None
Technical-support hours (eastern time)	24 hours, 7 days	11:00-8:00 M-F	Midnight-9:00 P.M. M-F	8:00-8:00 M-F noon-8:00 Sat. Sun	8:00 A.M.-8:30 P.M. M-F	8:00-8:00 M-F	8:30-8:00 M-F

N/A—Not applicable. The product does not have this feature.

price range. Ultimately, the color tracking issue and lack of text crispness make the 700p Plus inferior to other monitors, such as the CTX PL7+ (\$360 street), Optique V75 (\$420), Philips 107MB (\$430), and Princeton EO750, all of which cost about the same or less.

The 900p is reasonable choice for most applications, though again, it is not a standout in its price range. User controls are notably easy to use, with a sophisticated menu that offers such niceties as color temperature adjustment in 100-degree increments. The 900p generally did well on our tests. We saw a slight dulling-down of colors, which was noticeable in photos, however. Text was less crisp than we'd ideally like to see, and there was some slight streaking, halos, and a marginal score of 78 percent on the Video Bandwidth Index test. You can find better 19-inch performers (such as the Compaq or iiyama monitors, also reviewed here) for about the same price.—MDS

Shamrock C709 M5

17" aperture-grille tube (0.25-mm stripe pitch), 1,024-by-768 (85 Hz); \$430 street. Milpitas, California; 888-901-8899, 408-934-9050; www.shamrockusa.com; 532 at www.pcmag.com/infolink.

● The Shamrock C709 M5 is a good monitor for mainstream business users. It placed ninth on our jury rankings for 17-inch models, boasting stunning color output, high video bandwidth, and easy-to-use controls for a moderate price.

The Shamrock delivered some of the best-looking photo images we saw, with excellent contrast, saturated color, superior detail, and an extended tonal range. Our test unit's screen geometry suffered only from barely noticeable flattening at the outer edges, and text was readable down to 6 points. The monitor also excelled in areas like registration, focus, and image stability, but it did have trouble resolving densely spaced one-pixel horizontal and vertical lines. The Shamrock C709 M5 produced enviable performance on both our objective and subjective evaluations. It's a find for use in all but the most demanding technical applications.—DL

Smile CA6738SL, CA6929SL

CA6738SL: 17" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,024-by-768 (85 Hz); \$270 street. CA6929SL: 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$620. Irvine, CA; 800-876-4532, 949-753-8899; www.smilekfc.com; 533 at www.pcmag.com/infolink.

● Disappointing image quality makes these monitors tough to recommend, even with their low prices. In our labs, we could not form the Smile CA6738SL's screen image into a straight rectangle, which was unusual among the tested monitors. There were minor moiré patterns and misconvergence problems but no user controls to adjust them. Focus was acceptable but not ideal. Colors were good, if a little bluish in tinge. We also noticed some screen halos. If price is your main concern, look to the Pixie 770 (\$250), which delivers better performance at a similar price.

Similarly, the Smile CA6929SL fell short of the mark in our testing. The numerous image-quality problems included moiré patterning that couldn't be adjusted, inconsistent focus that was at its worst in the center of the screen, pronounced screen haloing, and a very low Video Bandwidth Index score of 68 percent. Colors seemed accurate and uniform during informal testing, but images in Photoshop were somewhat out of focus. Pass this one by in favor of the affordable and acceptable 19-inch MaxTech, Optique, or Pixie bargains.—BB

PC-MAGAZINE
 EDITOR'S CHOICE

Optquest V95	Panasonic PanaSync SL90	Philips 109 S	Pixie 995	Princeton AGX900	Samsung SyncMaster 900p	Smile CA6929SL	Sony GDM-400PS Multiscan	TeleVideo SVP300	ViewSonic PS790
18.0	18.0	17.9	17.7	18.0	18.0	18.0	18.0	18.0	18.0
\$600 street	\$700 street	\$700 street	\$480 street	\$750 street	\$720 street	\$620 street	\$860 street	\$650 street	\$750 street
Shadow mask	Shadow mask	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Shadow mask
Hitachi	Matsushita	Hitachi	Hitachi	Sony	Hitachi	Hitachi	Sony	Hitachi	Matsushita
0.26	0.22	0.22	0.22	0.22	0.22	0.26 (diagonal)	0.25	0.26	0.22
17.7 in./48.4 lbs	16.3 in./47.3 lbs	20.3 in./54.0 lbs	25.5 in./47.0 lbs	18.7 in./56.9 lbs	19.4 in./49.6 lbs	17.0 in./63.8 lbs	17.9 in./55.1 lbs	18.9 in./54.5 lbs	16.3 in./47.3 lbs
76 Hz / 88 Hz	76 / 89 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	75 Hz / 85 Hz	76 Hz / 88 Hz	76 Hz / 88 Hz
103 Hz / 116 Hz	104 Hz / 116 Hz	75 Hz / 85 Hz	85 Hz / 95 Hz	104 Hz / 115 Hz	75 Hz / 85 Hz	75 Hz / 95 Hz	75 Hz / 85 Hz	105 Hz / 117 Hz	102 Hz / 116 Hz
■	■	■	■	■	■	■	■	■	■
VGA	VGA, BNC	VGA	VGA	VGA, D-sub mini	VGA, BNC	VGA	VGA, BNC, D-sub mini	VGA	VGA, BNC
■ / N/A	□ (\$53) / 4	■ / N/A	□ (\$50) / 4	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A
■ / N/A	■ / N/A	■ / N/A	□ (\$50) / 5	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A	■ / N/A
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years
None	2 business days	2 business days	3 business days	2 business days	2 business days	None	2 business days	3 business days	None
10:00–9:00 M–F	24 hours, 7 days	8:00–8:00 M–F	11:30–8:30 M–F	24 hours, 7 days	24 hours, 7 days	8:30–5:30 M–F	24 hours, 7 days	8:00–6:00 M–F	10:00–9:00 M–F

Sony CPD-200GS Multiscan, GDM-200PS Multiscan, GDM-400PS Multiscan

CPD-200GS Multiscan: 17" aperture-grille tube (0.25-mm stripe pitch), 1,024-by-768 (85 Hz), \$580 street. **GDM-200PS Multiscan:** 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (85 Hz), \$800. **GDM-400PS Multiscan:** 19" aperture-grille tube (0.25-mm stripe pitch), 1,600-by-1,200 (75 Hz), \$860. San Jose, CA; 800-352-7663; www.sony.com/displays; 534 at www.pcmag.com/infolink.

● All three of these Trinitron-equipped monitors produce generally good images, but the 17-inch Sony CPD-200GS Multiscan offers the best value and image quality.

The Sony CPD-200GS is a bit more expensive than other business-class monitors, but superior performance makes the cost justifiable. The monitor placed fifth among 17-inch units on our jury rankings. It uses Sony's new short-neck Trinitron tube, which produced a stable and sharp image in our labs. The Video Bandwidth Index score (93 percent) was excellent, as was the convergence test, making this monitor a fine choice for text editing. Image geometry was excellent, and the only possible flaws to pick out were a slight moiré effect and a red tint to some dark gray shades.

The CPD-200GS is a fine choice.

The more expensive Sony GDM-200PS Multiscan is aimed at graphics and CAD professionals, delivering higher resolutions and refresh rates for the additional cost. In our labs, too, it produced superior images. This unit was excellent at convergence, bandwidth, and image regulation. The only minor flaws were a similar red tint to midrange gray scales and some small curves at the corner of the image that could not be completely corrected by the screen geometry controls. High-res users may want to trade up to the Sony GDM-400PS, but we were just as happy with the images on the CPD-200GS.

The 19-inch Sony GDM-400PS produces good-quality images but not quite best-in-class for the price. Convergence and image-size regulation were excellent, but the unit showed moderate shifts in black and gray levels when the image changed, only a fair score on the Video Bandwidth Index test, and some minor proportion distortions at different parts of the screen. There were also strong moiré patterns that could be reduced but not eliminated with the monitor's controls. The GDM-400PS simply does not offer as much value as the

similarly performing iiyama VisionMaster Pro 450 (\$700 street) or the Princeton AGX900 (\$750 street).—AP

TechMedia Ventanna 770

17" Inver shadow-mask tube (0.28-mm horizontal dot pitch), 1,024-by-768 (85 Hz), \$350 street. Garden Grove, CA; 800-379-0077, 714-379-6677; www.techmediacomputer.com; 535 at www.pcmag.com/infolink.

● The TechMedia Ventanna 770 is a good choice for business and SOHO users. It produces clear, rich colors and crisp, well-drawn—if slightly gray—text. Focus was excellent, with smooth, well-formed characters down to 7 points. The Ventanna suffered from underpowered vertical bandwidth (it scored a low 78 percent on our bandwidth index), which manifests itself in a noticeable grayness in text and thin lines.

Test images in Photoshop were excellent. Color registration was superb, and screen geometry was precise but for some slightly malformed circles along the edges. We also saw some minor image-regulation problems and noticeable haloing. But the Ventanna 770 is still a reasonable choice for almost any home or office task.—JL

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17- and 19-inch Monitors

TeleVideo SVP270, SVP300

SVP270: 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (90 Hz); \$470 street. **SVP300:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (75 Hz); \$650. San Jose, CA; 800-835-3228, 408-954-8333; www.televideoinc.com; 536 at www.pcmag.com/infolink.

● These two competitively priced models should satisfy most mainstream and high-end professionals. In our labs, the TeleVideo SVP270's contrast was excellent, even with dark colors, and text was sharp. Some color combinations, such as black text on a white background, revealed a minor red tint on the edges. The on-screen controls eliminated all visible moiré and

ViewSonic G773, PT775, PS790

G773: 17" Invar shadow-mask tube (0.23-mm horizontal dot pitch), 1,024-by-768 (87 Hz); \$480 street. **PT775:** 17" aperture-grille tube (0.25-mm stripe pitch), 1,280-by-1,024 (89 Hz); \$550. **PS790:** 19" Invar shadow-mask tube (0.22-mm horizontal dot pitch), 1,600-by-1,200 (76 Hz); \$750. Walnut, CA; 800-888-8583, 909-869-7978; www.viewsonic.com; 537 at www.pcmag.com/infolink.

● These three monitors from ViewSonic offer respectable value for the money. The 19-inch ViewSonic PS790 proved the best of the lot. It uses the new wide-deflection yoke, and so its depth is only 16.3 inches—about an inch shorter than 17-inch ViewSonic models. Image quality



in our labs was good, and the unit placed among the top ten on our jury rankings. We noted good convergence and focus on our tests, but the PS790 also had strong halos and minor proportion problems in some regions of the image. As a result, we consider the PS790 best suited for general-purpose use rather than high-end graphics or design work.

Performance from the 17-inch ViewSonic G773 was mixed; it's better suited to text applications than graphics. For example, the G773 showed excellent bandwidth index results, excellent convergence, and a crisp image. On the other hand, it exhibited moderate moiré patterns, tints that ranged from tan to midlevel gray tones, only fair screen geometry, and noticeable movement on our screen regulation test. For word processing and other standard applications, the G773 should suffice but not thrill.

corrected minor color registration problems, and the well-thought-out on-screen menus almost make up for the difficult manual, which is written in imperfect English. With its consistently pure colors and stable, attractive images, this monitor is a good pick for almost any home or business purpose, particularly image editing.

Much the same can be said for the 19-inch TeleVideo SVP300, although the SVP350 is better suited to text. The monitor was ranked third among 19-inch units by our jury, and it placed second on the Microsoft Word portion of that judging. Indeed, text was crisp and unbroken. The user controls reduced but could not eliminate all moiré. White color blocks revealed a slight sepia tint, but contrast was generally good. If you're looking to buy a 19-inch monitor, the SVP300's sharpness makes it a good bet for desktop publishing and detailed text tasks.—*RSA*

The ViewSonic PT775, equipped with an aperture grille, produced much better images. Built-in convergence controls, combined with an excellent bandwidth index score and sharp images, make this ViewSonic unit an excellent choice for text editing. Screen geometry was also excellent. The only weaknesses we found were an inability to adjust for dark gray tones without bringing up the black level (as with the G773) and faint halos. If you need aperture-grille precision and USB, this monitor is well worth considering.—*AP PC*

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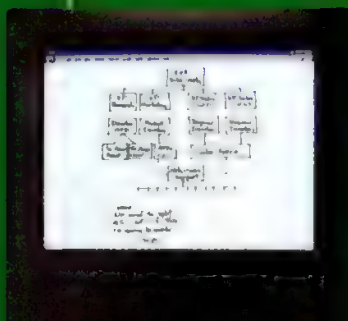


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THE NEXT MAJOR LANGUAGE FOR WEB AND APPLICATIONS DEVELOPMENT STANDS POISED TO CHANGE THE WAY WE WORK WITH DATA DRAMATICALLY. HERE'S HOW IT WORKS, PLUS A LOOK AT 27 PRODUCTS TO HELP ENABLE OUR FUTURE.

BY BEN Z. GOTTESMAN

matters

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>>>>>>>> WHEN YOU SEARCH THE WEB today using the keywords *Baltimore* and *orioles*, you'll get lots of interesting information about the baseball team—which is great, unless you're researching the Maryland state bird. You get unsatisfying results not necessarily because of a bad search query or algorithm but more likely because of the limitations of HTML itself. HTML is simply a presentation language: Its job is not to describe the content of a page but rather how that content will be displayed. What is needed is a language that provides a means of describing data in order to direct you to the results you want more easily.

The latest language to hit the Web—eXtensible Markup Language (XML)—appears to be the answer. This technology promises to move the Internet forward into a whole new and more powerful era of computing—and in every way imaginable, not just for searching. XML is not a presentation language, but by providing a common language for describing data, it will enable more precise searching, let businesses share data more efficiently, and make navigating data much easier. The great enabling technology of the cur-

XML vs. HTML in Database Applications

Refining a traditional database query requires a complete round-trip session from the browser through the Web server to the database and back again. Using XML, the query results are extracted from the database and can be further refined on the client. XML on the client currently requires a special application or browser plug-in such as IE4's XML parser.

1 You query the database for the Northeast region, looking for sales records on all account executives. Here, no difference exists between how an HTML-based system and an XML-based system work, sending the query to the Web server, which then passes it to the database, which returns the desired information.

Sales Database: Make Query

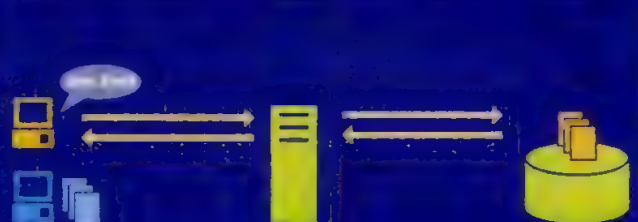
Sales Region	Northeast
Sales Rep Name or ID	
Additional Query Info	



2 You decide you want the information for John Smith. In an HTML application, you make another query and get the records from the database. With XML, that information was returned with your original query and is sitting on the client. You can mine the information that's already available—without going back to the database.

Sales Database: Search Results

Sales Region	Northeast
Sales Rep Name or ID	Adams, Cynthia Adams, Cynthia Hammert, Helen Miller, Randy Smith, John



3 You check John's records. Using the buttons, you can move to the next or previous sales rep's records. With XML, the necessary data is already available, meaning that you don't have to create another database query.

Sales Database: Sales Representative Record

Sales Rep Name or ID	John Smith
Region	Northeast
Sales Rep Title	Sales Rep
Quarterly Bonus	\$10,000
Phone	(201) 555-1234
Fax	(201) 555-1234
Email	jsmith@worldwide.com



4 If you begin a new search for the Southeast region, the process starts over, continuing like our initial query for the Northeast region.

Sales Database: Make Query

Sales Region	Southeast
Sales Rep Name or ID	
Additional Query Info	



rent age of the Internet has been HTML, the language used to define the presentation of all the pages we encounter on the Web. HTML has given us the ability to combine text and graphics on a page and create an intricate system of hyperlinks between pages. But HTML isn't very useful when it comes to describing information. For example, you can use HTML to format a table but not to describe that table's data elements. This is where XML comes into the picture.

XML and HTML both grew out of the Standard Generalized Markup Lan-

guage (SGML). SGML is a *metalanguage*—a language that lets you create other languages. SGML allowed various groups and industries (such as the airline industry) to create tags, elements, and attributes, called Document Type Definitions (DTDs), specific to their applications. But whereas HTML is a specific instance of SGML—a fixed set of tags specifically designed to display Web pages—XML is a metalanguage, like SGML, that grew out of a need for something simpler than SGML to describe documents on the Web.

What makes XML so powerful is that any type of data—even abstract data concepts—can be given form and structure. You give data concepts, such as *customer* and *inventory*, form by describing their components and the relationship between those components. Instead of a *customer*, you have a specified structure that describes customer-related information, such as customer name, account number, and address. Once you have created the structure, you group the data together in a document and serve it up to the world.

XML is used to define the structure of data rather than to describe how the data will be presented. You define data structures using markup tags. Unlike HTML, XML lets you define your own tags, giving you control over the document structure. You can also define attributes for XML

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tags. Most HTML attributes are used for formatting, but most XML attributes provide additional information regarding the data structure—for example, a flag that determines whether a customer account can be processed.

XML'S CHILDREN

XML's roots are in describing documents such as the contents of a manual, but the language can be used to describe virtually any type of data, from Web page content to financial transactions, vector graphics, mathematical formulas, multimedia content, and remote procedure calls. The rash of XML-based standards submitted to standards bodies in recent months is evidence that developers and end-user communities have been starved for a non-proprietary method of describing data.

In this world of the Internet, intranets, and extranets, the need for open standards is readily apparent: To work together, computers need to speak the same language. Consider OFX, the Open Financial Exchange specification that is currently SGML-based but is purported to be moving to XML in the near future. The OFX DTD provides a standard language for banks to allow their customers to manage their finances online. By agreeing on a single standard, banks needn't build in specific support for every personal finance application out there, such as Quicken and Microsoft Money. The single standard lets its customers download account statements and pay bills electronically. On the flip side, Quicken and Money don't have to do a great deal of work to support nearly any financial institution. As long as the bank can describe a transaction using OFX, the applications can read it.

X MARKS THE SPOT

As you can see from the OFX example, standards are very important, but the question remains: Why does the standard have to be defined using XML? The answer lies in XML's X: eXtensibility. Because XML is extensible, XML-based data can go beyond the definitions of a particular DTD. For example, a DTD for booksellers may simply require *title*, *author*, *price*, and *availability*. A particular bookseller may decide that it also wants to include tags for *rating*, *reviews*, and *comments*. This is no problem.



Applications that need only the data specifically defined in the DTD will ignore this additional data, while applications that can use the additional data will do so.

ACRONYM MADNESS

If you thought that HTML, HTTP, IMAP, LDAP, FTP, SMTP, and the like were a large enough group of acronyms to add to your everyday vocabulary, XML provides fresh opportunities to overwhelm you with all the acronyms that represent new standards based on XML. In addition to OFX, more than a dozen other XML-based languages (with acronyms in tow) are emerging.

If you run Microsoft's Internet Explorer 4.0, you may have already used XML without even realizing it. The Channel Definition Format (CDF) that IE4 uses to define channels was one of the first XML-based languages.

Among the other XML-based standards, either finalized or on the drawing board, are the Resource Definition Format (RDF), which will help Web sites describe themselves and provide a rating of their content; Vector Markup Language (VML) and Precision Graphics Markup Language (PGML) are two proposals for describing vector graphics; the Information and Content Exchange (ICE) protocol will be used to help syndicate data for multiple uses on the Web; and Synchronized Multimedia Integration Language (SMIL) will provide a means to link text, audio, graphics, and animations.

SMIL is already being used in RealNetworks's RealSystem G2. Netscape Navigator 5.0 will use RDF to store bookmark and history information. And, of course, you'll see a whole host of industry-specific DTDs, just as there are today for SGML.

People are creating products, not just new languages, based on XML. Microsoft's Chromeffects, which should be available for Windows 98 and NT later this year, will use XML as an interface to DirectX, making it easier for developers to integrate multimedia and 3-D on Web pages.

HTML KILLER?

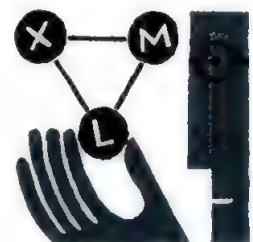
Since XML can describe nearly anything, will XML ultimately replace HTML?

Maybe yes, maybe no. The World Wide Web Consortium, the Web's governing body, has said that XML will be used for future extensions to the language after HTML 4.0. But the existence of an incredible number of HTML documents today means that HTML in its current form will be supported for years to come.

But XML and HTML are not mutually exclusive. XML can be used in today's HTML documents to provide metadata—data about the data in the document. IE4 can work with XML data today, and Netscape Navigator should have similar capabilities in the next major revision of the browser.

The actual impact of XML remains to be seen, but the amazing speed of its adoption in products and defining standards certainly seems to indicate that its implementation is imminent. The spectrum of products, either shipping or announced, that support XML is almost as wide as that of software itself. In the pages that follow, we show you 27 products that are incorporating XML today or will do so in the near future. The products range from high-end server applications to next-generation office suites and browsers.

So yes, there is a lot to be excited about, and you'll definitely be hearing more about XML and its many applications in the months ahead. But perhaps it should have been called ACL (Acronym Creation Language).



> XML 201 <

With its unbridled potential and limitless range and influence, XML is shaping up as the next big thing in applications development, particularly for Internet applications. Getting a grasp of how XML works and an introduction to some of its most important offshoots will help you see how XML aims to be a complete solution for creating applications for your data management needs.

XML Authoring Tools

In many situations, such as database queries, applications will automatically output data in XML format. In other situations, such as creating small, static data files, you'll want to create XML using an authoring tool.

1 Entity Definition

Before creating an XML document, we need to define the elements (fields) and attributes (field descriptors) it will use, as well as whether or not it will reference or incorporate a Document Type Definition (DTD).

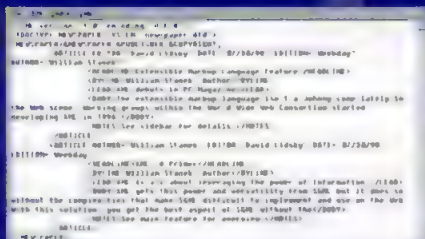
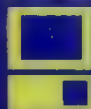
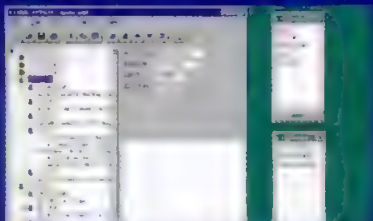
- ☒ Data Source Definitions
 - A. News Database
 - B. Text File caps.txt
 - C. Text File args.txt

- ☒ Structure Overview
 - Newspaper
 - Article
 - Headline
 - Byline
 - Lead

- ☒ Element Definition
 - Entity: Article
 - Rules:
- ☒ Attribute List:
 - Name Author
 - Rules
 - Name Editor
 - Rules
 - Name Date
 - Rules

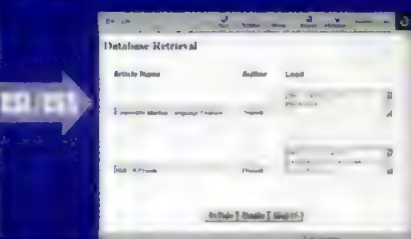
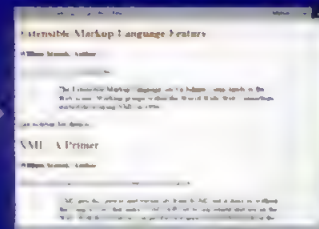
2 Document Creation

With authoring tools such as Vervet's XML Pro, we defined an XML document by dragging elements into the tree structure on the left and defining each element's attributes in the box on the upper-right-hand side of the screen.



3 Document Contents

XML describes information, not its layout. This lets you separate presentation from content. With the use of an XSL or CSS stylesheet or server-based scripting, we can take the same XML document and present it in the most appropriate format, be it a database record, a published article, or a series of abstracts.



CREATING XML

Since XML doesn't rely on predefined tags and attributes, you have complete control over the structure of data in an XML document. You define the tags for components within the document, you add attributes to these tags as necessary, and you decide how the components fit together.

The general set of rules for a document's tags and attributes is defined in a Document Type Definition (DTD). A DTD lets you create a consistent structure for the type of document you want to display. You don't have to write a DTD: If your XML document is structured properly within the language's rules, it is called *well-formed XML*.

To interpret the various data structures within a document, the application relies on a tool called a *parser*. The parser extracts information from the document and passes it back to the application for processing or display.

XML parsers look at the structure of an XML document to determine if a document is constructed properly. Parsers can be validating or nonvalidating. A *validating parser* checks that the document

conforms to the DTDs specified within it. This is important for enabling a smooth interchange of data between companies that are using the same DTD.

Once the DTD for a particular type of data is created, you either insert the DTD directly into the document or reference it from within the document. A combination of the two operations can also be done.

Next you need to create the body of the XML document. There are several ways to do this, and the method you choose depends primarily on how the data will be used and how often the data changes.

If you are working with fixed data records that change infrequently, you may want to create the necessary data structures using an authoring tool. In that case, you just insert the data directly into a document and save the result to a file so that it can be viewed directly in an application or compatible browser. You could then publish the document on the Web where others could access it using the appropriate URL. When you need to make updates, you would load the document into your authoring

tool's editor, make the necessary changes, and then publish the updated document.

If you are working with data that changes frequently, a more dynamic solution that lets you create documents on the fly is more appropriate. To do this, you would use a document publishing or content management system. These systems are usually integrated with a database. The database stores data records so that they can be retrieved on demand. The management system reads in the data and converts it to the appropriate structure, then passes this data off to an application or browser for viewing.

PRESENTING XML DOCUMENTS

Although XML gives structure to your data, you cannot use conventional XML to specify how data is to be rendered. One way to format XML data structures is to combine them with HTML. To do this, you have to create *XML islands* within standard HTML documents. HTML is used to format the contents of the document, including the data, and XML is used to define the structure of the data.

Another formatting solution for XML is to create a stylesheet detailing how each piece of the data structure should be for-



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matted. While a Cascading Style Sheet (CSS) could be used to do this, you could use the stylesheet language designed specifically for this purpose, called XSL (eXtensible Stylesheet Language).

Using XSL, you specify how to extract information from an XML document and how to format this information for viewing. Often, XML data is transformed into another format, such as HTML—as is the case with Microsoft's XSL processor.

FILLING IN THE GAPS

Just as XML did not provide a means for displaying documents, necessitating the creation of XSL, other proposed extensions to XML should make it easier to develop XML applications. XML-Data and XML Namespaces should aid in XML development.

XML-Data brings XML back to its roots as a language for working with data structures. With XML-Data, you create schemas that describe the characteristics of various data structures. You define how the structures are used, how they are grouped together, and how different structures are related.

If you are familiar with XML DTDs, you might be thinking that schemas sound a lot like DTDs, and you'd be right. Schemas provide functionality similar to DTDs. But because XML-Data schemas are written in XML, they are easy to use and completely extensible, making them much more powerful than DTDs.

Also worth noting is that XML itself does not have very strong data types; everything is pretty much a text string. This could turn out to be a big limitation of XML. But XML-Data provides the stronger data typing that XML lacks. For example, with a date field, you have no way to enforce that valid dates are entered into the field. When you need to place limitations upon what type of data can be entered into a field, you can do that with XML-Data but not with XML.

A complementary technology to XML-Data is the *XML Namespaces* definition. The goal of XML Namespaces is to provide a more accurate identification of data structures so that you can access the document structures and avoid conflicts with documents that may use other like-named structures.

When each structure has a unique

name, your documents can use markup defined in multiple schemas. For example, all Excel XML data, such as `<formula>`, are clearly labeled so they won't conflict with other XML data that might use the same *account number* tag.

One use for this technology would be to insert sales data, customer purchases, and inventory records into a single document without having to create a separate schema for this combined document type. In that scenario, you would use XML Namespaces to take advantage of the schemas already defined for these data types.

As you can see, XML will create and enable a whole new world of applications. Each of the following sections will spotlight the productivity or development-tool markets in which XML stands poised to make the biggest splash, the role XML plays in these environments, the products that are early adopters of this technology, and the way they use it.

—William Robert Stanek



> AUTHORIZING TOOLS <

Creating XML documents isn't an easy task. Before you get started, you need to decide how to structure data within the documents. Unfortunately, the way you structure purchase orders is very different from the way you structure instruction manuals. To make matters worse, you may need to define the data structures in DTDs, which aren't exactly user-friendly. Enter XML authoring tools, which make it easy to define data structures and create documents using those structures.

Most XML authoring tools on the market are actually integrated XML/SGML authoring tools. The reason: Since XML is a subset of SGML, extending existing SGML tools so that they are compatible with XML is easy. As with HTML authoring tools, the best XML authoring tools let you create documents using an intuitive graphical interface.



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What sets XML authoring tools apart from HTML authoring tools is the heavy emphasis on structures and tags that you need to define in a DTD. And you might have to import structures and tags from an existing DTD before you create a document. Fortunately, most authoring tools also include a DTD creation utility and solid support for working with XML structures. Other features you should look for in a full-featured authoring tool include utilities for converting document formats, a stylesheet designer for specifying document formatting, and a developer's toolkit for customizing the authoring tool or integrating it into a document management system.

Near & Far Designer (\$1,395 list) is used only to author DTDs; it is not used for creating XML documents. You can model complex structures graphically—using tree diagrams to model the structure of a DTD, for example. The tool lets you convert SGML DTDs to XML DTDs and has drag-and-drop features that let you copy structures in one DTD and paste them into another. Beyond DTD creation, you can also convert to and from various DTD formats. For example, current SGML users will find that you can easily convert SGML DTDs to XML DTDs. (Microstar Software Ltd., Nepean, Ontario; 800-267-9975 www.microstar.com; InfoLink 555.)

If you want a full-featured authoring tool for creating XML and SGML documents with point-and-click ease, **Adept•Editor** (PC version with quantity discounts, \$1,350 list) is a good choice. XML support in Adept•Editor is superb, and you can easily convert documents from SGML to XML and vice versa. The product includes a utility for creating DTDs and designing stylesheets, giving you everything that you need to define data structures and detail how they should look on the screen. (ArborText Inc., Ann Arbor, MI; 734-997-0200; www.arbortext.com; InfoLink 556.)

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*Service and Reliability Survey, PC Magazine, July 1998

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- Internal 100MB Zip Drive with one cartridge
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- 3rd-Generation DVD-ROM Drive
- SoundBlaster AudioPCI 64V Wavetable 3D Sound
- Altec-Lansing ACS-490 Dolby Surround Sound Speakers with subwoofer
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- 3rd-Generation DVD-ROM Drive
- SoundBlaster AudioPCI 64V Wavetable 3D Sound
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- 56K V.90 PCI Fax/Modem* w/Voice Mail and Speakerphone
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- SoundBlaster AudioPCI 64V Wavetable 3D Sound
- Altec-Lansing ACS-490 Dolby Surround Sound Speakers & subwoofer
- Quantex ATX Mid Tower Case
- MS Natural Keyboard Elite with MS Mouse
- MS Windows 98
- Power Multimedia Software Bundle
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- 56K V.90 PCI Fax/Modem* w/Voice Mail and Speakerphone
- 32X Max EIDE CD-ROM Drive
- Aureal "A3D" 3D Positional PCI Sound
- 3Dfx Voodoo2 based 3D Game Accelerator w/12MB
- MS SideWinder 3D Pro Joystick
- Altec-Lansing ACS-45 1 Speakers w/Subwoofer
- Quantex ATX Mid Tower Case
- MS Natural Keyboard Elite with MS Mouse
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- Activision Game Titles: Battlzone, Heavy Gear Interstate 76 w/Nitro Pack

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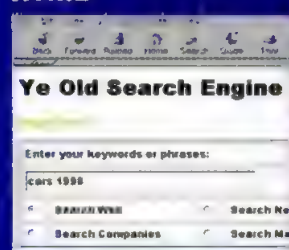
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Searching Using XML

HTML-based search tools use keywords and text. XML-based search tools use data structure and metadata. The XML approach, once implemented, should make finding information much easier.

HTML

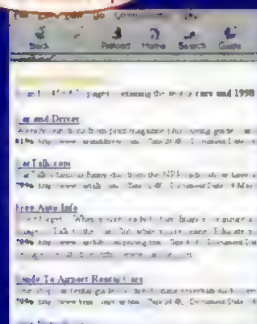


cars 1998

Web server

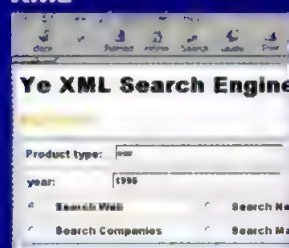
Internet

Found 3,458,671 pages



The HTML-based search tool returns lots of information on cars, but it's all over the map. You're also likely to get hits for The Cars (the rock band), as well as for 3.5 million other sites that contain the value cars or 1998 anywhere on a page.

XML



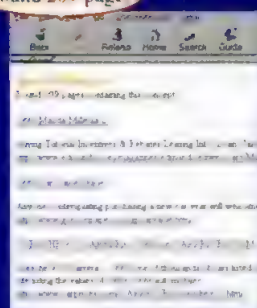
cars

1998

Web server

Internet

Found 209 pages



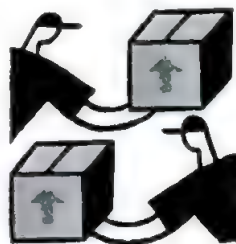
The XML-based search tool will be more efficient, returning 209 pages containing exactly what you were looking for. This is because the XML search tool will check your query against a cars DTD that contains tags such as <MODEL YEAR>.

FrameMaker+SGML 5.5 (starting at \$1,995 list) delivers sophisticated control and flexibility in an authoring environment. You'll find an easy-to-use scrolling menu list from which to select XML elements, attributes, and overall document structure. The product lets you publish documents to HTML, PDF, PostScript, SGML, and XML, giving you flexibility. With combined support for XML, DTD, and stylesheet creation, you have everything you need to roll out XML documents. Toss in a fully extensible API for customizing the application environment and you have a well-rounded product.

FrameMaker lets you easily flow DTD structures. Using the Structure View, you can see the complete structure of a document and rearrange it using a drag-and-drop feature. FrameMaker also lets you create stylesheets for documents. You can set rules for color and formatting using simple dialogs. (Adobe Systems Inc., San Jose, CA; 408-536-6000, www.adobe.com; InfoLink 554.)

On the other hand, a more basic product is **XML Pro** (starting at \$149.95 list). XML Pro is a top-notch XML editor but not a whole lot more. It lets you create and edit documents using intuitive, well-

organized menus and screens. For ease of use, the product includes wizards that help you add elements and attributes to documents. Currently, there is no support for document conversion, DTD creation, or stylesheet design. (Vervet Logic, Bloomington, IN; 812-856-5270; www.vervet.com; InfoLink 557.)—WRS



> DATABASE AND DATA INTEGRATION SOLUTIONS <

Using a database to manage information is a long-standing practice, but XML is driving a new generation of database and data integration solutions. Typically, databases use XML to structure information extracted from the database so that it can be distributed and published more easily.

Object-oriented database vendors claim

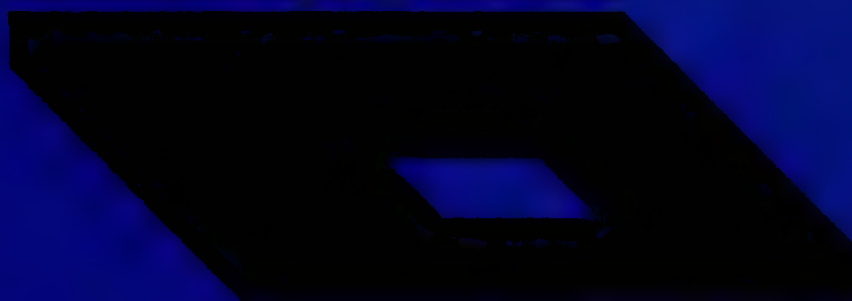
that their products provide the best performance, because the structure of an XML document in many ways mirrors the structure of an object database. By contrast, relational databases depend on code to map the XML model to relational structures. This additional work required to use a relational database gives an edge to object databases.

Data integration solutions use XML to automate the exchange of data. In general, with an integration solution, XML serves as an interface layer or wrapper for data being passed between data sources, making it possible for a wide variety of applications, legacy systems, and databases to exchange information.

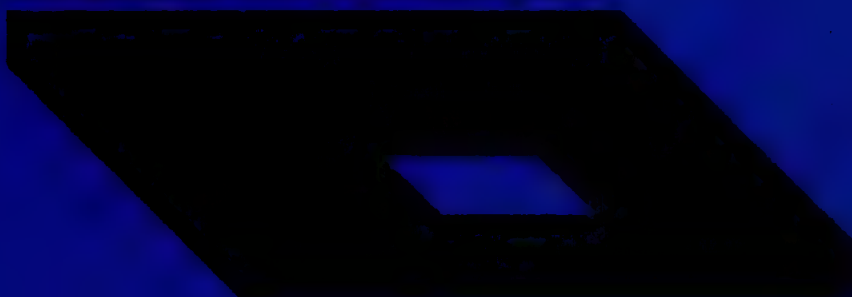
ObjectStore PSE Pro (price varies by project: developer license, \$3,050 list; runtime client, \$825) is the object database management system embedded in Astoria and DynaBase. With an object-oriented database like ObjectStore, you access structures in the database directly as XML without having to write or maintain mapping code or execute runtime joins. XML structures can be created by developers and stored directly in the database. (Object Design Inc., Burlington, MA; 800-962-9620;



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- Removable Combo 24X Max^^ Variable CD-ROM and 3.5" Floppy Disk Drive
- NEW 2X AGP 8MB ATI Rage Pro 3D Video
- ESS 3D Surround Sound and Hardware Wavetable
- Smart Lithium Ion Battery
- Internal 56K Capable* Data/Fax Modem
- MS Office 97 Small Business Edition v2.0
- Microsoft Windows 98
- Touchpad
- 3-Year Parts and Labor Limited Warranty†

- ★ Upgrade to 96MB SDRAM, add \$99.
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- ★ Custom Leather Case, add \$99.

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Parsers

Parsers read the data structures in XML documents and extract the information the data structures contain.

NOT WELL FORMED OR VALID

The code in this document doesn't contain a root element and the **PRODUCT** element is improperly nested.

```
<?XML version="1.0" encoding="UTF-8"?>
<!DOCTYPE CATALOG SYSTEM "catalog.dtd">
<PRODUCT NAME="Color Monitor" IDNUM="CM-657">
<PRICE MSRP="$299.50" WHOLESALE="$187.45" />
<NOTES>Recently selected as #1 color monitor
</PRODUCT></NOTES>
```

WELL FORMED, NOT VALID

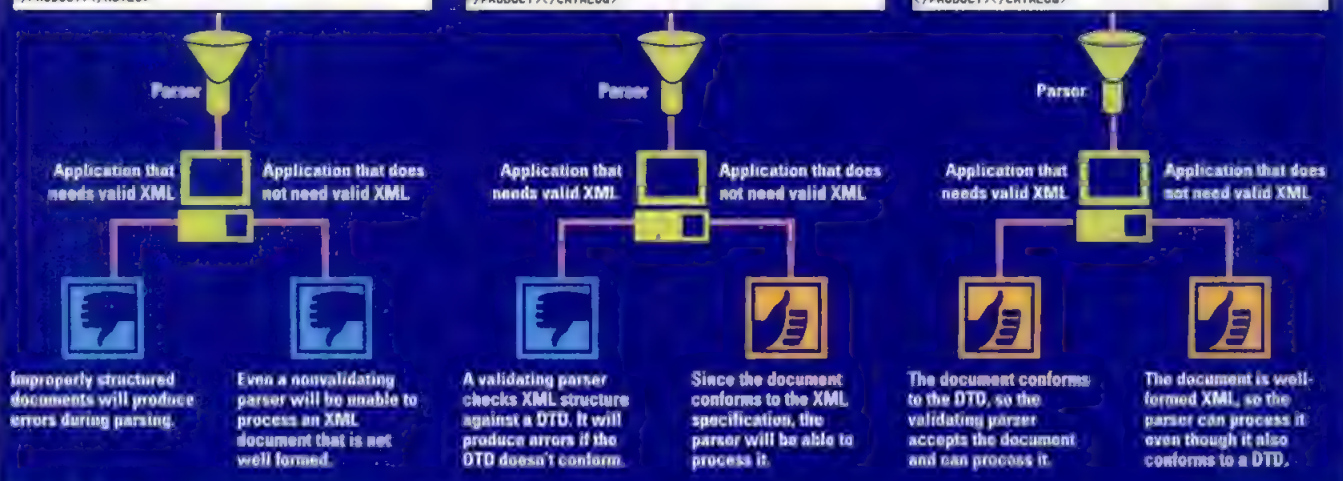
The code in this document is structured correctly but does not conform to a DTD. You can also have a document that is structured correctly but doesn't refer to a DTD.

```
<?XML version="1.0" encoding="UTF-8"?>
<!DOCTYPE CATALOG SYSTEM "catalog.dtd">
<CATALOG><PRODUCT NAME="Color Monitor" IDNUM="CM-657">
<PRICE MSRP="$299.50" WHOLESALE="$187.45" />
<NOTES>Recently selected as #1 color monitor</NOTES>
</PRODUCT></CATALOG>
```

WELL-FORMED AND VALID

The code in this document is structured correctly and conforms to the DTD.

```
<?XML version="1.0" encoding="UTF-8"?>
<!DOCTYPE CATALOG SYSTEM "catalog.dtd">
<CATALOG><PRODUCT NAME="Color Monitor" IDNUM="CM-657">
<PRICE MSRP="$299.50" WHOLESALE="$187.45" />
<NOTES>Recently selected as #1 color monitor</NOTES>
</PRODUCT></CATALOG>
```



www.objectdesign.com; InfoLink 558.)

Virtual Database Management System (VDBMS) from Junglee (price varies based on data sources and subscription rate) takes data from many different sources and creates a single relational database interface to all the data sources. Afterward, you can use XML to map the various structures used by the data sources to a common syntax for easy access. Finally, you use a set of publishing rules to extract information on demand and publish it. The result is an HTML- or XML-based Web site that can update itself whenever the related data sources change. To get a peek at how Junglee does it, check out the classifieds sections and the low-price finders it powers at a number of public Web sites, including washingtonpost.com's classifieds and Yahoo!'s comparison shopping tools at shopping.yahoo.com. (Junglee Corp., Sunnyvale, CA; 408-617-1900; www.junglee.com; InfoLink 573.)

Web Automation Toolkit (Starter Bundle including five developer licenses, \$19,995 list) offers a complete solution for integrating and publishing information from multiple data sources. With this product you can create a business service application that

tracks orders, then use the service to enable the exchange of data between applications that need to process orders. XML is the glue that makes describing each aspect of the business service possible, and it is also used to provide the message format for transferring data. (webMethods Inc., Fairfax, VA; 703-352-8501; www.webmethods.com; InfoLink 559.)—WRS



> XML PARSERS <

Behind the scenes of any application, be it a word processor, database, or graphics, is software that takes data and puts it in a format that the application can understand. With applications that read XML, this processor is called a *parser*. The end user typically doesn't have any control over which parser is being used,

but the developer must decide which parser is the most appropriate to integrate into an application or perhaps to build one from scratch.

XML parsers come in two flavors: those that validate documents and those that simply ensure that the document is "well formed." A *validating parser* ensures that the document conforms to the DTDs specified within it; a *nonvalidating parser* simply checks that the document is "well formed"—that it conforms to the basics of the XML specification. The type of parser you need depends primarily on how you plan to use XML.

Validating parsers tend to be much larger than nonvalidating parsers and require more processing power. If the XML data in your application doesn't need to be verified against a DTD, you may be better off with one of the nonvalidating parsers.

All the products we looked at are free.

MSXML has both validating and nonvalidating versions. The nonvalidating parser, written in C++ and distributed as an ActiveX control with IE4, is optimized for speed and efficiency. The validating parser, written in Java, is designed to provide

error-handling and validation features when needed. IE4 has the nonvalidating parser, but the IE5 beta-1 parser is validating (see the Browsers section of this story for more information). (Microsoft Corp., Redmond, WA; 425-882-8080; www.microsoft.com/xml; Info-Link 551.)

XP is a nonvalidating parser written in C, hence faster and more efficient than a Java parser. This will be the parser bundled with Netscape Navigator 5.0, making it much more visible in the near future. A key plus for this parser is that it provides both high- and low-level APIs for working with XML documents. (James Clark; www.jclark.com/xml/expat.html; InfoLink 560.)

XML for Java, from IBM Corp., offers some of the best validation features in any parser. The product's parser classes and methods for validating document structures are well designed, making it easier for developers to validate document structures. But the parser lacks the strict error handling you may want for XML data interchange. Normally, you should expect to have those features within a fully validating parser. (IBM Corp., Armonk, NY; www.alphaworks.ibm.com/formula/xml; InfoLink 514.)

Ælfred is a nonvalidating parser designed especially for Java applets. Together, all its parser class files are less than 26K, and they're only 15K when placed in a compressed JAR file—a real dream if you are looking to minimize download times. (Microstar Software Ltd., Nepean, Ontario; 800-267-9975; www.microstar.com; InfoLink 555.)

In many ways, **DataChannel XML Parser (DXP)** is an ideal counterpart to Ælfred. DXP was designed to be a validating XML parser that provides the capabilities necessary for XML-based data interchange—strict error handling and strong validation of document structure. It is best suited for use in Java applications. (DataChannel Inc., Bellevue, WA; 425-462-1999; www.datachannel.com; InfoLink 561.)

Lark and **Larval** are also Java-based parsers. Lark is a nonvalidating XML parser, Larval a validating parser built on the original Lark code base. You'll find that both are compact enough to be practical for use with Java applets. But the class files have more overhead and size than is ideal. (Tim Bray; www.textuality.com/Lark; InfoLink 562.)—WRS



> BROWSERS <

XML and HTML may look similar, but a Web browser cannot understand XML without a little help. A browser needs a built-in XML parser to read XML pages, and today, only IE4 offers the extended functionality required to work with XML data files. But being able to read the file is not enough. The file must be associated with a stylesheet or script in order to present the data in a usable format. Otherwise, try to open an XML file by itself and you'll likely get a bunch of run-on text.

Microsoft Internet Explorer 4.0 is the first browser to support XML. To do this, IE4 uses the MSXML parser (discussed in the XML Parsers section of this story). In

addition, an add-on is available for processing stylesheets that can format XML data structures. This add-on, the MSXSL parser, also an ActiveX control, reads the XML data and XSL stylesheet and renders it properly in the browser window. Since the XML data is represented in the browser's object model, you can also write script to manipulate and display the data. Even in IE4, you can load XML only by using the MSXML ActiveX control in an object tag within an HTML page.

To allow developers to manipulate XML documents, Microsoft implemented the XML Object Model. This model makes it easy to process and dynamically update the data structures in XML documents. Simply use Microsoft's JScript or JavaScript to make the dynamic updates.

For **Internet Explorer 5.0**, scheduled for release late this year or early next year, Microsoft has expanded support in the included parser for the XML specification. Now the parser also supports XML Data Islands (embedding XML code into HTML documents), XML Data, and XML Namespaces. (Microsoft Corp., Redmond, WA; 425-882-8080; www.microsoft.com; InfoLink 551.)

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When it comes to XML support, Netscape is playing a bit of catch-up. The first version of Communicator to support XML will be **Netscape Communicator 5.0**, which should be available in beta by the end of this year. In Communicator 5.0, XML support will be implemented with the XP XML processor, which is one of the best in its class—good news for Netscape. Communicator also plans to support stylesheets for XML pages via CSS (Cascading Style Sheets). (Netscape Communications Corp., Mountain View, CA; 650-254-1900; www.netscape.com; InfoLink 563.)



> OFFICE SUITES <

The previous generation of office productivity suites made great strides in integrating better with the Web. Word processors especially became good tools for authoring HTML documents. But unfortunately, once a document was converted to HTML, it could not be brought back into the suite application without a significant loss of fidelity. The layout of the imported HTML document didn't match the original file, and the file's nonformatting attributes, such as spreadsheet cell formulas and word processing annotations, did not return.

One of the major goals of the next generation of suites is to provide full round-trip capabilities: Save a document to the Web and import it back into the suite and you won't notice a difference. XML will likely play a central role in achieving this round-trip compatibility. And a by-product should be better compatibility between competing suite products.

Lotus Development Corp. is emphasizing round-trip capabilities in the latest version of its suite, **Lotus SmartSuite Millennium Edition**. When SmartSuite saves to HTML, it will be able to open the resultant file in the suite applications again with minimal loss of fidelity. SmartSuite HTML files will also be compatible with

those used in **Lotus eSuite**, Lotus's Java suite of applications. But unlike Microsoft, Lotus is not using XML to store the extended attributes required by the suite application. Instead, the program will make extensive use of HTML metatags. Though the SmartSuite's HTML files conform to XML standards for well-formedness, this is really the most basic of XML support. (Lotus Development Corp., Cambridge, MA; 617-577-8500; www.lotus.com; InfoLink 564.)

There's little doubt that Microsoft Corp. will be leading the field in XML integration when it releases **Microsoft Office 2000**, expected sometime early next year. When a document is saved to the Web, Office 2000 will store both the HTML version, to display the document properly in a browser, and the XML version, to display the document properly when it is opened back up in an Office application. The XML and HTML versions will be stored within the same file. The XML/HTML combination file will be offered as a companion format to the more common DOC, XLS, and PPT binary formats found in Office today.



Microsoft will make extensive use of XML Namespaces, which will clearly identify the Office application to which the XML tags apply.

So considering this information, will Lotus be behind Microsoft when it comes to XML integration? Yes, but Lotus's decision appears to be a wise and pragmatic one.

Since XML is all about interoperability, it doesn't make sense for Lotus to define a unique set of

tags for SmartSuite applications only to have Microsoft, by far the market leader in the suite arena, define a completely different set. Rather, Lotus has chosen to wait for Office 2000 to set the standard. Once Office 2000 ships, Lotus should be able to integrate Microsoft's tags into its own suite. Of course, the ease with which Lotus will be able to do this will depend heavily on Microsoft's willingness to make the Office 2000 DTDs public. (Microsoft Corp., Redmond, WA; 425-882-8080; www.microsoft.com; InfoLink 551.)

Corel Corp.'s efforts are in some ways ahead of and some ways behind the other

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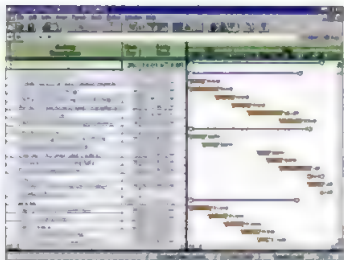
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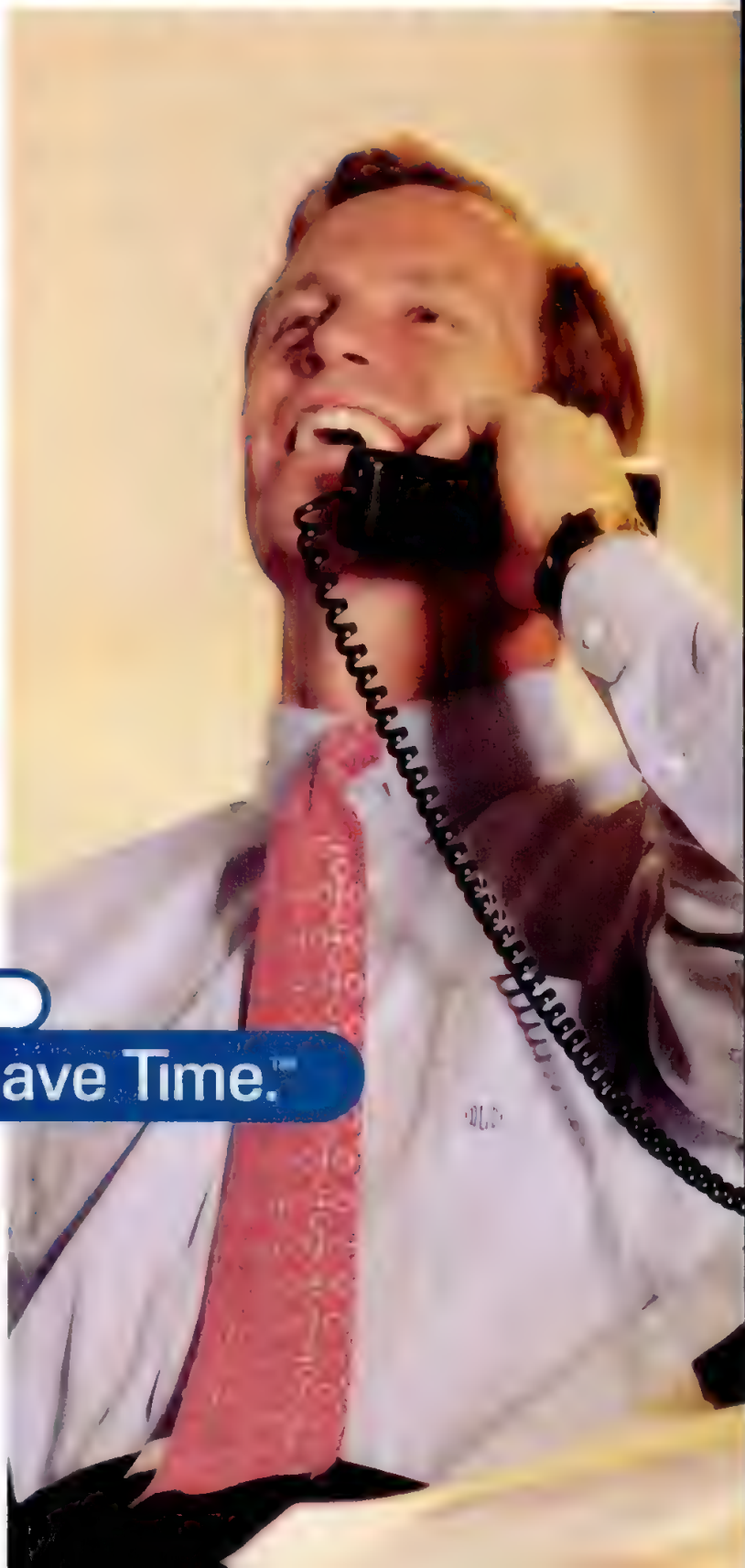


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two office suites. **Corel WordPerfect Suite** has long had SGML editing capabilities. In the next version of Corel WordPerfect Suite, planned for early 1999, XML editing features will be added. Users will be able to define their own tags either in a DTD syntax or from within WordPerfect for well-formed documents.

Corel is also working with XML in its OpenJ technology, which is still in the research and development stage. OpenJ uses XML to assemble applications dynamically using JavaBeans. For example, a basic word processor component may give you only core functions such as creation and editing of text. If you need to insert a table into your WordPerfect document, for example, you will be able to request the component from the server, and it will be delivered to you dynamically.

To enable this to work, Corel uses XML as the basis for a markup language called ADML (Application Description Markup Language). ADML is used to describe dynamically the application logic necessary to create server-based applications, and it does so through connections between JavaBeans. This lets components on a server build client applications on demand. To do this, the server components use ADML templates rather than compiling Bean adapters and serializing Bean data so it can be stored in a persistent format—a shortcut that makes creating applications on the fly very easy to do. (Corel Corp., Ottawa; 613-728-3733; www.corel.com; InfoLink 565.)—WRS



➤ APPLICATIONS DEVELOPMENT ENVIRONMENTS ◀

When off-the-shelf products for your move to an XML-based environment don't provide the solutions you need, an application development environment can come to the rescue. For example, if you need to convert legacy document formats to XML before they are published,

you may find that your only choice is to develop your own solution. And if you need to integrate a legacy database into a Web environment, customization may be the only avenue available to you.

Most XML development environments include interfaces for creating XML-based extensions to databases and Web servers.

On the database side, you'll use the extensions to add XML structures to data after it is extracted from the database. On the Web server

side, you'll use the extensions to access and publish the data. Usually, a developer's toolkit also contains utilities for converting document formats to XML or a combination of XML and HTML.

Balise 4 (single-user development license, \$3,000 list; single-platform site license, \$7,000) is an applications development environment for SGML and XML. Using a JavaScript-like language, you can create scripts that convert documents to and from XML, manipulate DTDs, and generate



documents in multiple formats. You can even create XML/HTML pages dynamically from database records. (AIS Software, Paris, France; +33-01-40-64-43-00; www.us.balise.com; InfoLink 566.)

Konstruktor (live site deployment, starting at \$60,000 list) uses the OmniMark programming language to extract information from text-based documents, manipulate the information, and deliver it as XML. The language is robust enough to build content management systems and dynamic content delivery servers.

Konstruktor also includes a framework for managing data within relational databases. You can use the framework to extract information from a database and create XML/HTML documents on the fly. The product also includes a load-balancing tool that is optimized to meet the high-availability needs of large-scale Web sites.

Konstruktor provides an application server framework you can use to develop customized application servers, including extensions for interacting with Web

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servers. Application servers can use OmniMark to read multiple data sources and structure them as XML. The XML can then be inserted into a content repository that resides in the relational database system of your choice. (OmniMark Technologies Corp., Ottawa; 613-745-4242; www.omnimark.com; InfoLink 567.)

Perspecta SmartContent System (server licenses, starting at \$30,000 list) is software for dynamically organizing and distributing your database information. You can use the system to build browser-based applications that use XML to leverage the information within your database. You work with Perspecta to build a metadata database and then tie it to a content management system, such as Vignette's StoryServer (discussed in the Document Management Systems section of this story), to do content production, content linking, and dynamic page generation.

XML comes into play with Perspecta, in that it can be the input and output format for metadata in the database you create. You can also choose to use XML as the means to create metadata and to organize it based on concepts within the data. The metadata, in turn, is used to structure the information contained in your documents and other data sources automatically so that it can be browsed visually. Behind the scenes, the Perspecta content server analyzes the metadata structures and the relationships they describe to determine how the information should be linked together and navigated. (Perspecta Inc., San Francisco; 415-437-4150; www.perspecta.com; InfoLink 568.)—WRS



► DOCUMENT MANAGEMENT SYSTEMS ◀

Leveraging the power of the information within a company's documents is what XML is all about. But to get at this information and use it, you may need a document management system. Document

management systems are designed to handle all aspects of the information found in your documents regardless of format or source, allowing you to search for and extract information with relative ease. Once the system finds the necessary information, XML can be used to structure it.

A document management system structures XML data on the fly based on templates created by a developer. Because XML describes the information and its structure, a document can combine output from multiple data sources in a single document and prepare it for distribution.

At the core of most document systems you find a content repository built on top of a database. The content repository stores collections of files, which can include multimedia and document files and the individual data structures within them, allowing that data to be indexed, searched, and extracted on demand.

To manage the repository, you use the document system's content management tools, which provide control over document access, tracking, and versioning. With these

controls in place, you can set up an environment for collaborative authoring of documents. Most document systems also include extensions for integrating with a Web server, letting you publish your documents online.

Vignette's **StoryServer** (starting at \$25,000 list) is a Web application platform that is used by large Web sites such as ZDNet, CNET, and the Tribune Co. One facet of the latest

version, 4.0, helps you manage online customer relations with Advanced Content Management, which provides support for XML-based content. The system lets site managers create Web sites that deliver personalized content. The content is more accurate than that created by traditional methods, because it's based on precise metadata rather than keywords. StoryServer also uses XML as a data format and as a means of integrating information from multiple documents and data sources.

On the horizon, Vignette, along with other partners, is developing the XML-



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based Information Content Exchange (ICE) protocol, which should allow for highly automated methods of repurposing and syndicating content. A large content provider such as ZDNet might use this to provide its content to other, more specialized sites—for example, a site dedicated to accounting that also provides its readers with some technology-related content. (Vignette Corp., Austin, TX; 888-608-9900; www.vignette.com; InfoLink 569.)

Astoria 3.0 (100 users, \$1,500 to \$2,000 per seat, depending on system requirements) uses ObjectDesign's object-oriented database, ObjectStore PSE Pro (discussed in the Database and Data Integration Solutions section of this story), as the basis of its content repository. XML helps the system work with virtually any content type. With structured documents, such as text or RTF files, XML is used to describe the various data elements within the document. With unstructured documents, such as graphics, video, and other multimedia files, XML is used to describe the file as a whole, so it can be used with other documents. (Crystal Software, San

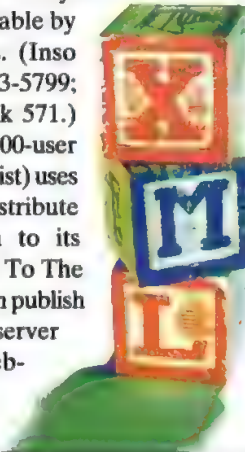
Diego; 619-676-7700; www.chrystal.com; InfoLink 570.)

DynaBase (depending on the size of the installation, \$47,000 to \$94,000 list) also uses ObjectStore as the basis of its content repository. As with Astoria 3.0, objects let the product represent elements within structured text files as XML and represent unstructured multimedia files as XML elements that can be inserted into documents. Beyond this, DynaBase's tightly integrated Web server solution makes it stand out. DynaBase 3.0 should be available by the time you read this. (Inso Corp., Boston; 800-733-5799; www.inso.com; InfoLink 571.)

DataChannel RIO (100-user license, starting at \$9,500 list) uses XML to organize and distribute customized information to its users. Using RIO's Save To The Web technology, users can publish documents to a Web server without needing a Webmaster as an intermediary. Documents can be

saved to folders that can be published as Internet Explorer channels. When a document is saved to the server, RIO prompts the user to enter keywords about the document. The document remains in its native format, but the keywords are stored as XML metadata. (DataChannel Inc., Bellevue, WA; 425-462-1999; www.datachannel.com; InfoLink 561.)

Frontier 5 (annual subscriptions, depending on usage and support, \$99 to \$5,999 list) is a content management system that runs on Windows or a Macintosh. While it can manage any type of content, its ability to manage Web sites stands out. Frontier's own site is an example. Frontier can connect to external systems using XML RPC (see Trends Internet in this issue), and it can use XML to manage data stored in its proprietary object database. Once in the database, the data is accessible via Frontier's flexible scripting features. (UserLand Software, Burlingame, CA; www.scripting.com; InfoLink 572.)—WRS 



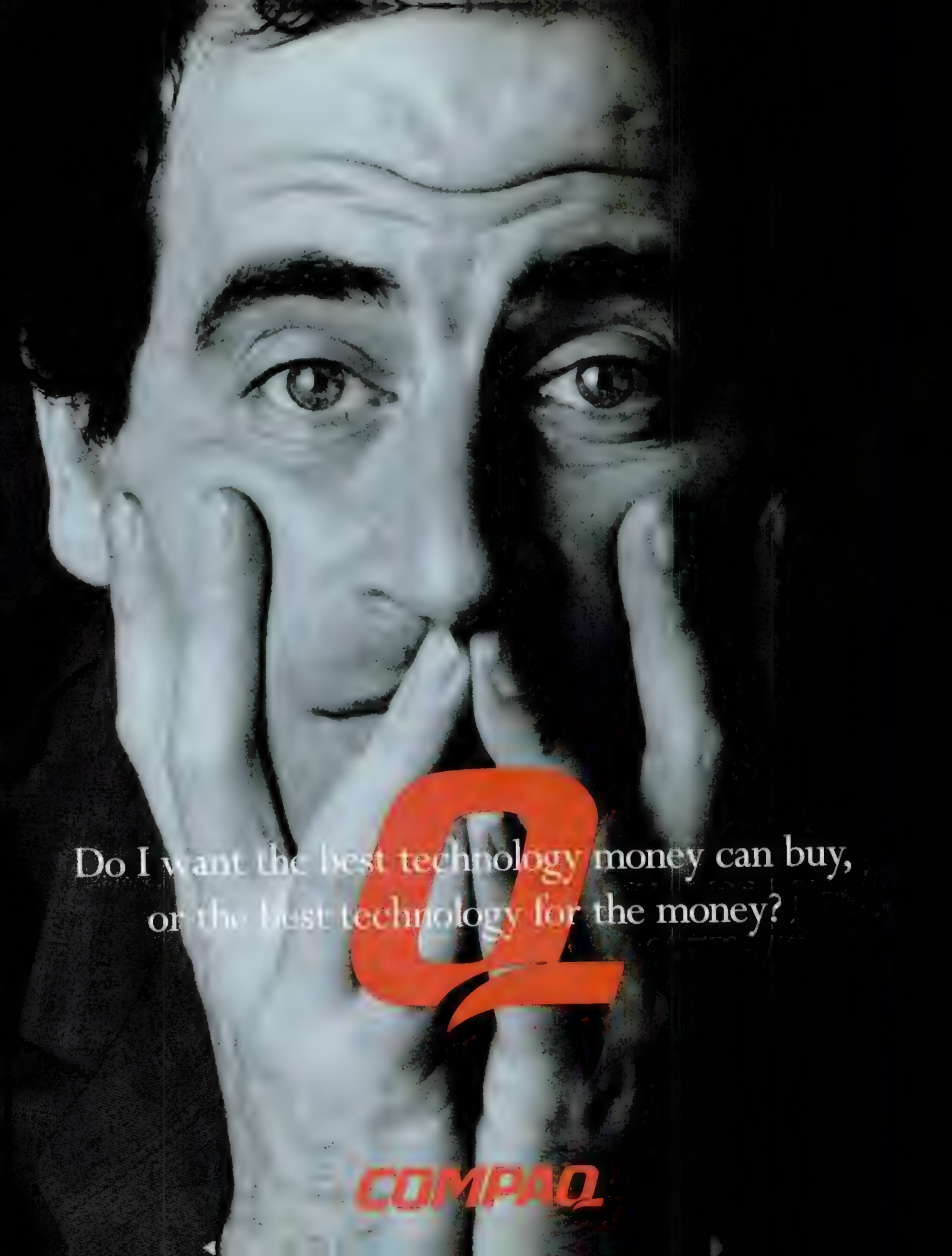
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- Additional Li-Ion Battery: **\$189***

Armada 7000 Series Options

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- ArmadaStation Tower Stand: **\$99***
- Compaq Briefcase: **\$99***

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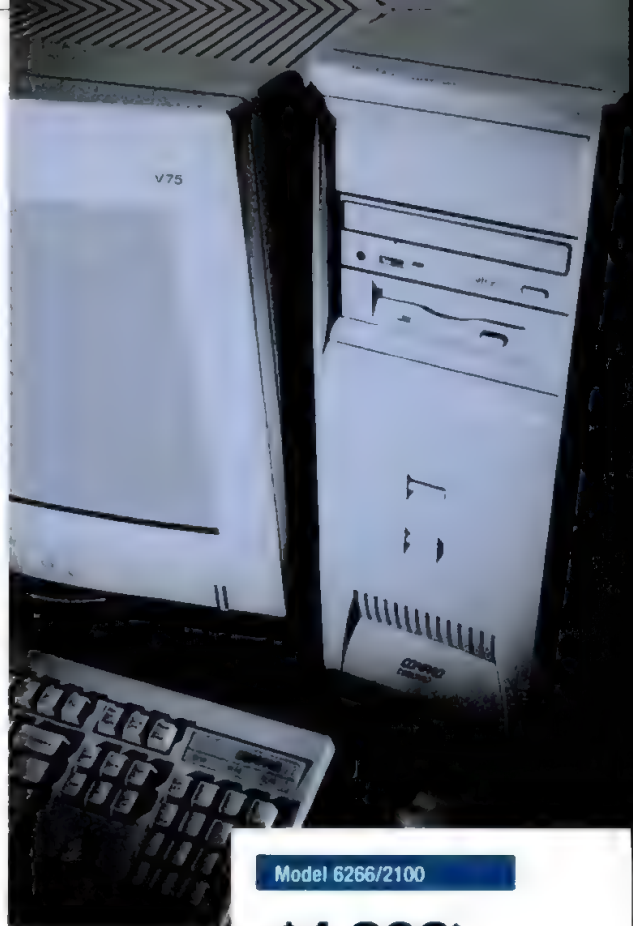
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Goodbye, Phone Bill?

If your company's calling costs are high, voice over IP gateways are an excellent way to save big on long-distance charges.

By Frank J. Derfler, Jr.

Voice over IP (VoIP) technology puts a new twist on pinching long-distance telephone pennies. The concept is simple: Use your existing IP network infrastructure to transmit voice calls, thus avoiding per-minute long-distance charges.

The best implementation of the technology takes the form of voice-to-IP gateways. Briefly, these hardware devices digitize analog signals from the telephone, compress the data and load it into IP packets, address the packets to a gateway at

the call's destination, and then send them over an IP network—either an intranet or the Internet. On reaching the destination, an identical gateway reverses the process, then routes the call from the IP network to the branch- or central-office PBX or onto the public telephone network (see the sidebar “How Voice over IP Works”).

Although we invited several companies to let us evaluate their products, only three agreed: Micom, Motorola, and NetSpeak. The VoIP gateway market comprises two dozen companies, rife with alliances. Motorola owns a significant financial piece

INSIDE

VoIP Realized? Voice over IP (VoIP) has come a long way since the days of choppy Web phones. Senior networking editor Frank J. Derfler, Jr., puts three VoIP gateways through their paces to see whether they're worthy business solutions.



Finally, a Simple Network: Networking USB-compliant PCs with AnchorChip's EZLink USB Network is as easy as plugging in a cord. ZD Labs' Steve Buehler gives you the full story. *Page 259.*

Mirror, Mirror: Disk cloning with multicasting can ease many network administrators' jobs. Contributor Arie Moller puts Symantec's Ghost Professional 5.0 and Micro House's ImageCast Deluxe 2.12 to the test. *Page 259.*

CDs for Everyone: A CD-ROM server can make sharing software a snap. Contributing editor Steve Rigney investigates whether the HP SureStore CD-ROM Server stands out from the pack. *Page 262.*



Corporate Video: Cisco's IP/TV brings MPEG-1 video to your business network. Contributing editor Jan Ozer tells you whether seeing is believing. *Page 262.*

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of NetSpeak, and each vendor has substantial joint-development agreements with Bay Networks. Bay Networks, in turn, is becoming part of Nortel, which owns Micom.

Some products—such as Mitel's voice-processing cards—have been on the market since mid-1996. But the VoIP gateway market is just now gaining momentum. Generally, we were impressed with the products' performance and surprised by their high levels of voice quality. Motorola's Vanguard family was the best, providing the richest, most flexible set of capabilities and the most mature software. It earns our Editors' Choice.

DOES VoIP MAKE CENTS?

Although VoIP gateways promise to provide free long-distance calling, it's not that simple. More accurately, they rearrange your costs. You trade per-minute telephone charges for the initial up-front cost of the VoIP gateway equipment. Initial costs will vary with the scale of the deployment, but they break down to about \$500 per line, plus installation and support. The equipment we used for testing—two sites with 24 lines each—ranged from about \$24,000 for Micom to nearly \$90,000 for NetSpeak. Most organizations will want to get their feet wet by deploying a VoIP pilot program in one department, perhaps using two 4-line, \$2,500 Motorola 320 units and then adding

capacity as needed.

So when does VoIP make sense for your business? Clearly, if you spend a significant amount on office-to-office calls over long distance—especially calls overseas—it's worth looking into. Moreover, VoIP can help you save further by letting you reduce the number of lines used between office PBX systems and local telephone companies. Of course, each organization is different and must work with its own breakeven and return-on-investment numbers. Consider this formula to help you determine how long it will take to pay for your VoIP system: Number of months = up-front costs divided by (pennies per minute x monthly call minutes) – monthly line-cost savings + monthly maintenance + added IP network costs.

To illustrate, let's say you invest \$35,000 in a central-site VoIP gateway and two branch-office gateways. If you pay 7 cents per minute to call between the central and branch offices and rack up 30,000 call-minutes per month, that saves you \$2,100 per month using VoIP. You might also cancel four PBX trunk lines costing \$60 each per month—for an additional \$240 savings. If you negotiate \$100 per month to maintain the VoIP equipment (and don't have added IP network costs), you'll break even in about 16

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VOICE OVER IP

months. In time, you might elect to cancel other types of lines or additional trunk lines for greater savings.

Note, too: There's a good chance you won't have an added IP network cost. Our testing confirmed vendor estimates that one active voice channel uses on the average about 4 to 6 Kbps of bandwidth. Conservatively, a dozen simultaneous conversations occupy less than 100 kilobits per second. Most organizations have enough unused capacity on existing IP networks to handle dozens of calls.

Though all this sounds good, realize that long-distance telephone charges continue to fall as well. Businesses can get a flat rate of 6 to 8 cents per minute, and it's within the capability of a company such as AT&T to reduce domestic long-distance charges to 0 cents per minute in the future; AT&T Wireless offers that deal today. If the saved pennies trickle away, VoIP gateways become a less compelling solution to most businesses. For more on the future of this technology, see the sidebar "VoIP in Your Life."

What our formula can't account for, though, is some degradation in call quality. Our jury testers were generally impressed with the voice quality of the products, but they found that many factors dictated by the IP network affected it—such as the amount of simultaneous traffic passing through the gateway, sampling and error-correction techniques, and dropped IP packets. For example, dropped voice packets caused voices to take on a rolling quality, some slurring, and gaps (see our benchmark tests).

There is also the problem of delay. Voice digitization takes a minimum of 37 milliseconds (ms) in an ideal system. This dampens interactive conversation and confuses first-time users. We found that a network round-trip delay of over 400 ms renders the system almost unusable. If you demand consistently good voice quality similar to POTS, we recommend using VoIP products on a private IP network where you can control conditions. The online version of this story includes the sidebar "Are You Ready for VoIP?", tips on preparing your network for this technology.

VoIP GATEWAY FACTS

VoIP technology evolved from a PC background, so most of the gateway products you'll find use PC chassis with software running over some flavor of Windows. Of those we tested, the Motorola Vanguard 6500 broke the mold by using a 68000-series processor and a proprietary operating system

EDITORS' CHOICE

• The Motorola Vanguard 6500 family



Free long distance; bypass Ma Bell. The promise of Voice over IP has been ringing for a few years, but not until now has the technology matured enough to compete as a

viable business solution. The three VoIP gateways we tested underscore this fact. Each offers good voice quality under controlled conditions (on an intranet); costs are coming down, and the hardware is rugged and reliable. But the Motorola Vanguard 6500 family offers a superior mix of flexibility, features, and price.

These Motorola units are whatever you want them to be. They offer the flexibility to fit into any size office environment while providing the heavy-duty construction associated with commercial telephone equipment. Yet the pricing is reasonable. Everything about the Vanguard 6500 series broadcasts a no-nonsense, "Let's do the

job" attitude. The gear doesn't even have an off switch! Centralized management is performed using SNMP, which lets you tightly integrate the devices into your existing network infrastructure. Here are products we confidently recommend.

The Micom gateways delivered comparable (and at times, even slightly superior) voice quality and used bandwidth more economically. These systems lack Motorola's flexibility and tight integration, however. Micom wins a strong honorable mention.

The NetSpeak gateways are built like tanks, but they're priced out of sight of the competition. Though we appreciated the products' low use of network bandwidth, voice quality suffered for it.

OTHER APPLICATIONS

VoIP in Your Life

The gateway solutions in our feature present just one scenario in which VoIP technology makes an impact. Consider three others.

TALK TO ME

An interesting VoIP application that's poised to take off is voice-enabled browsers. Imagine that you're shopping at an e-commerce site; you click on a product and are immediately connected to a live human being who can take your order or answer questions. From a technical point of view, this feat requires little more than putting an IP gateway in front of an existing call center and adding some code to the Web site. (The hope is that customers will have good sound cards in their PCs.) VoIP and Web integration services are already here: MCI and NetSpeak provide a joint service called Click'nConnect, and Ericsson has a service called Phone Doubler Quick Call.

BAD-BOY PHONE COMPANIES

New telephone companies such as Delta Three are challenging traditional long-distance phone carriers by offering cheap long-distance service over the Internet. To use the service, you dial a stream of numbers from any phone (perhaps using a prepaid calling card), connect to the carrier's public VoIP gateway, and hitch a ride on VoIP to a point near your destination—typically in another country. From there, the call reaches its destination via that country's local public switched tele-

phone network. The upstart companies anger traditional public carriers and their governments, because they avoid many of the taxes traditional carriers pay and don't contribute to special pools of funds that support Internet access for schools and libraries.

VoIP IN EVERY POT

VoIP's future may be much grander than anything seen today. It may entirely replace the circuit-switched public telephone networks used by local and long-distance carriers. *Circuit switching*, the telephone technology from the first half of this century, provides good voice quality, but it's expensive to maintain. The network is made up of tens of thousands of redundant computerized switches that must be tended by highly paid technicians in telephone switching centers worldwide. If VoIP attains the voice quality and reliability it needs to replace circuit switches with fewer and smaller packet switches, hundreds of phone companies will benefit from enormous cost savings.

Signs of interest are everywhere. Bell Atlantic has begun constructing a next-generation long-distance network for the purpose of supporting "audio and video streaming." Sprint announced a five-



year, \$2 billion development program for the Integrated On-Demand Network, which promises to combine voice and data and cut the cost of a typical voice call by 70 percent. Lucent recently rolled out the PacketStar IP Switch, a Layer 3/Layer 4 WAN routing device with a 64-gigabit switching capacity. It can terminate 16 of the OC48 circuits (32,256 voice channels each) designed to carry the backbone traffic of major cities. Vocal-Tec's Ensemble Architecture product line aims at "widescale deployments of centrally managed, reliable, scalable, and secure commercial IP telephony services." AT&T and VocalTec have teamed up to form ITXC, a company created to provide sophisticated billing and gateway service exchanges for ISPs entering telephony. And coming from the data side, Ascend, Cisco, Nortel, and 3Com are all moving to bring Signaling System 7 (SS7) to their routers and high-level switches. SS7 is the control system for today's long-distance public circuit-switched network.

Voice over IP Implementations

VoIP covers an expanding range of products and services. Here's a breakdown of the major categories.

Technology	What is it?	Pros	Cons	Available
PC Web phone	Software that lets any PC with a sound card transmit voice over the Internet.	Call any similarly equipped PC worldwide for what it costs to connect to the Internet.	Poor voice quality; requires you to prearrange calls	Since 1995
VoIP gateway	A hardware device between a PBX and an IP network that transmits voice traffic.	Reduces local and long-distance phone bills.	Variable voice quality; high initial cost	Now
Public IP voice carrier	An alternative phone company that uses VoIP gateways	Immune from traditional telco taxes; provides cheap phone service	Available only in specialized markets; subpar voice quality	Now
Voice-enabled browser	A Web technology that provides voice access through a browser.	Provides personalized, live customer service for Web sites and e-commerce.	None.	In 6 to 12 months
Public switched network replacement	A large IP packet network that replaces traditional circuit switching	Much cheaper to support than circuit switching	Variable voice quality	Over the next 10 to 15 years





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VOICE OVER IP

called ONS. The products all provide centralized management, but each takes a different approach. Micom uses a technique based on Traveling Software's LapLink, Motorola uses SNMP, and NetSpeak provides a proprietary network management utility. Although each method worked well, we preferred SNMP because of its universality.

Our hands-on experience taught us that gateway installation is a specialized skill. You'll probably use a value-added reseller (VAR) to install your equipment. Pick the VAR as carefully as you pick a product; the reseller must possess both telephony and IP networking skills and must be as familiar with the brand and model of each of your PBX systems as with IP addressing and routing.

At this stage, there is little or no interoperability among VoIP products, though most vendors, including those here, are developing software that conforms to the H.323 standard.

But the vendors say privately that H.323 doesn't solve all the interoperability problems. Plenty of detailed fitting and pruning will still

be needed before different VoIP gateways can interoperate.

Note that if you're primarily interested in saving money on faxing, you should opt for a fax gateway instead. Such devices offer many more services and options (for details, see "Cyberfaxing," *PC Magazine*, April 21, 1998). Though VoIP gateways provide fax capability, they must recognize and specially demodulate fax transmissions to provide good quality. Of the three, the Micom and Motorola products have this capability, but we didn't test it.

Finally, you can get the benefits of today's VoIP technology from other equipment as well. Router companies are transforming their existing equipment into do-anything boxes that act as firewalls, filter URLs, and

transmit voice packets. You can even add VoIP gateway cards and software to some models of Ascend, Cisco, and 3Com routers that you may already own. Adding VoIP capability to an existing device might make sense in some instances, but we prefer the dedicated VoIP gateway approach. Networking and telephony are still very different animals. Read on to see which gateway products best suit your business.

Micom V/IP Gateway System Model GS4, GS8

GS4: Starting price, \$3,995 list; tested configuration, \$9,985.

GS8: Starting price, \$5,995; tested configuration, \$11,985.

Micom Communications Corp., Simi Valley, CA; 800-642-6687, 805-583-8600; www.micom.com. 900 at www.pcmag.com/infolink.

● Micom, a Nortel (Northern Telecom) company, is no stranger to the digitized voice market. We previously awarded the Micom Net-Runner 75E Integration Router an Editors'

PERFORMANCE TESTS

Voice over IP Gateways



As expected, the voice quality of these VoIP gateways decreased as line conditions worsened. Generally, the Micom and Motorola products demonstrated high voice quality—almost on a par with POTS (plain old telephone service)—whereas the NetSpeak unit's sound quality fell a bit short.

To evaluate voice quality, we used a mix of jury ratings and systematic testing. Our two tests, Conversation Quality and Speech Intelligibility, each reflect real-world tasks: maintaining a voice call that lets two users engage in a typical conversation and providing voice quality that sounds clear and natural. We conducted the tests between two gateways on a simulated IP network. To vary network conditions, we introduced impairments that simulated a range of network conditions—from optimal to those resembling Internet traffic.

For the Conversation Quality test, we placed two testers on opposite ends of the connection, isolating each so they were unable to hear the other's voice outside the earpiece. Each took turns reading aloud from a script with short exchanges of dialog simulating conversation. The testers rated the conversation's quality on a scale of 1 to 5—1 being unusable and 5 being equivalent to a POTS system. They repeated the drill for each product under four sets of conditions: low (50-millisecond latency, no errors), medium (200 ms, 1 bit error in 1,000,000), high (400 ms, 1 bit error in 500,000), and very high (600 ms, 1 bit error in 20,000).

Under good line conditions, the jurors rated the Micom V/IP Gateway System GS8 and Motorola Vanguard 6560 equally—almost as high as POTS. The NetSpeak WGX/24IPTT demonstrated lower (yet still acceptable) voice quality. Voices on the latter system had an artificial, processed-sounding quality, punctuated by artifacts and slightly choppy words. Voice quality for all three products suffered under high impairment levels—and even more so under very high impairment levels, which reflect an Internet connection at its worst.

Our Speech Intelligibility ratings reflect how well four jurors could understand and report words heard across the network. The index of voice quality is the percentage of words heard correctly. They listened to words from the PB-50 lists on S&VC's Speech Intelligibility Test and Measurement Disks—a set of CDs designed to aid in audio tests. Each test involved listening to 20 specially selected words; testers wrote down the words they thought they heard or deemed certain words unintelligible.

Here, the WGX/24IPTT showed higher numbers than the V/IP GS8 and Vanguard 6560 when no errors were introduced on the IP network. Though its output sounded processed, the WGX/24IPTT's voice quality was crisp, allowing for good intelligibility. But under the worst line conditions (very high), the WGX/24IPTT failed to maintain all 12 concurrent calls. Its documentation describes a feature that lets the gateways adapt to different line conditions, but we saw no evidence of this. Both the V/IP GS8 and Vanguard 6560 performed better than the WGX/24IPTT and similarly to each other. Their ability to handle much heavier traffic than the NetSpeak unit indicates that the packets these products transmit carry error-control information.

It's interesting to note how each gateway product handled network utilization. Motorola configured the Vanguard 6560 unit we tested using sampling and transmission methods. This resulted

Choice ("Divide and Conquer," February 6, 1996) among a field of voice + data multiplexer products. The Micom V/IP Gateway System Model GS4 (\$3,995 list) and GS8 (\$5,995 list) are offspring of the NetRunner, and as we expected, these products performed well—comparably in many areas to the Motorola systems—while using less bandwidth.

Geared to central-site installations, the V/IP GS8 we tested holds hardware for one T1 or E1 line (24 or 30 channels). For the branch office, we tested the lower-end V/IP GS4, which works with a maximum of 8 analog or 16 digital channels and holds two analog foreign-exchange line adapters. Expect to negotiate a package price with a Nortel reseller or VAR that includes installation, product updates, and full system support.

Until now, Micom has focused its VoIP business on digitization and communications cards; the integrated gateways are new products and should be available by press time. Although the V/IP GS4 and V/IP GS8 gateways we test-

ed were still in preproduction, the designation applied to the cabinets only, not to the cards. The boxes weren't as beefy or rugged as the Motorola and NetSpeak devices, but the final versions will likely be on a par with them. More important, Micom (like Motorola) maintains the important ISO 9001 certification, which means manufacturing processes and quality control are monitored by an independent body.

In addition to testing the V/IP GS4 and GS8, we also set up gateways using Micom V/IP voice cards in PCs. The V/IP card and software packages have been on the market since December 1996. As with all the products we tested, the power of the CPU isn't critical; each card has a 40-MIPS (million instructions per second) digital signal processor to do the work, and the data travels between cards on a separate bus that doesn't interfere with the PC.

Each Micom T1 adapter handles a maximum of four lines—a smaller increment than with the Motorola and NetSpeak products,



FOR EVERY NEED: The GS8 is geared for central-site installations; the GS4 is targeted at the branch office.

in very high network utilization (3 percent or 399 frames per second) and points to some inefficiency. The V/IP GS8 demonstrated substantially lower network utilization (1 percent or 86 fps, with FEC turned on) yet delivered comparable voice quality. The WGX/24IPTT's network utilization (0 percent, 32 fps) was the lowest, but because it didn't devote extra packets to error correction, sound quality suffered.

The bottom line? We don't recommend implementing VoIP gateways beyond a private network. Moreover, our findings underscore the importance of knowing the details of your private

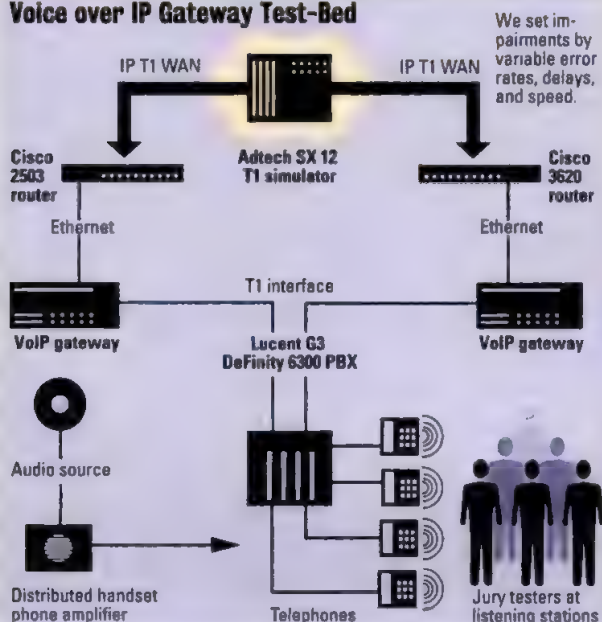
IP network, such as the typical bit error rate and the delay between the origin and the destination. At a minimum, you should infer this information with tools such as Traceroute.—*Analysis written by Russell O. Iwanchuk and Ryan Snedegar*

How We Tested

We attached the gateways to a Lucent G3 Definity 6300 PBX via T1 lines. On the IP side, we connected them over Ethernet to Cisco 2503 and 3620 routers, each with a T1 interface. Then we connected the routers to an Adtech SX 12 T1 simulator, which let us add voice delay, bit errors, and burst errors, and limit the data throughput rate. We kept the data rate at 1.54 Mbps for all tests and changed only the delay and bit error rates.

We tested pairs of gateways by making 12 concurrent calls between them for each test run. We manned four lines with our testers and loaded the remaining eight lines with continuous music, which maximized the workload for each gateway and prevented the products from activating silence compression.

Voice over IP Gateway Test-Bed



JURY TESTS

Bold type denotes first place.

PC denotes Editors' Choice.

High scores are best.

Impairment level

Low Medium High Very high

CONVERSATION QUALITY (average jury rating on a scale of 1 to 5)

	Low	Medium	High	Very high
Micom V/IP Gateway System GS8	4	4	3	1.5
Motorola Vanguard 6560	4	4	3	2
NetSpeak WGX/24IPTT	3	3	3	1

SPEECH INTELLIGIBILITY (words identified correctly)

	0%	50%	50%	50%
Micom V/IP Gateway System GS8	81%	85%	88%	44%
Motorola Vanguard 6560	81%	85%	88%	44%
NetSpeak WGX/24IPTT	79%	80%	80%	44%

N/A—Not applicable: The WGX/24IPTT was unable to complete our test at this error level.

▲ As the scores for our jury tests illustrate, all three products provided fairly good voice quality when subjected to low and medium impairment levels.

However, as conditions on the network worsened, our jurors found it increasingly difficult to communicate.

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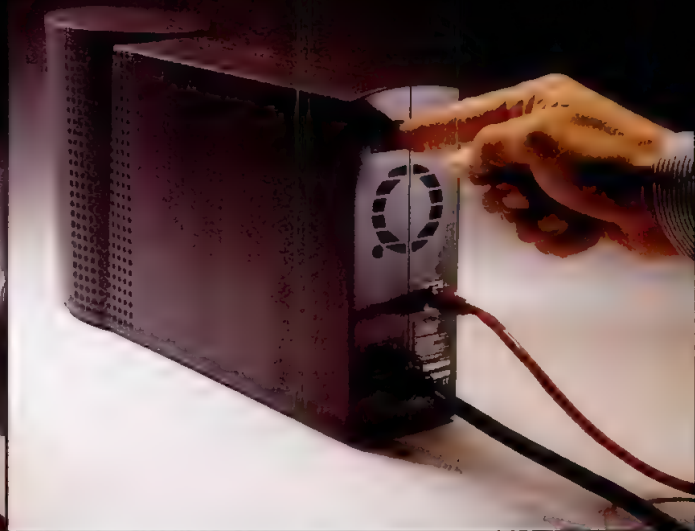
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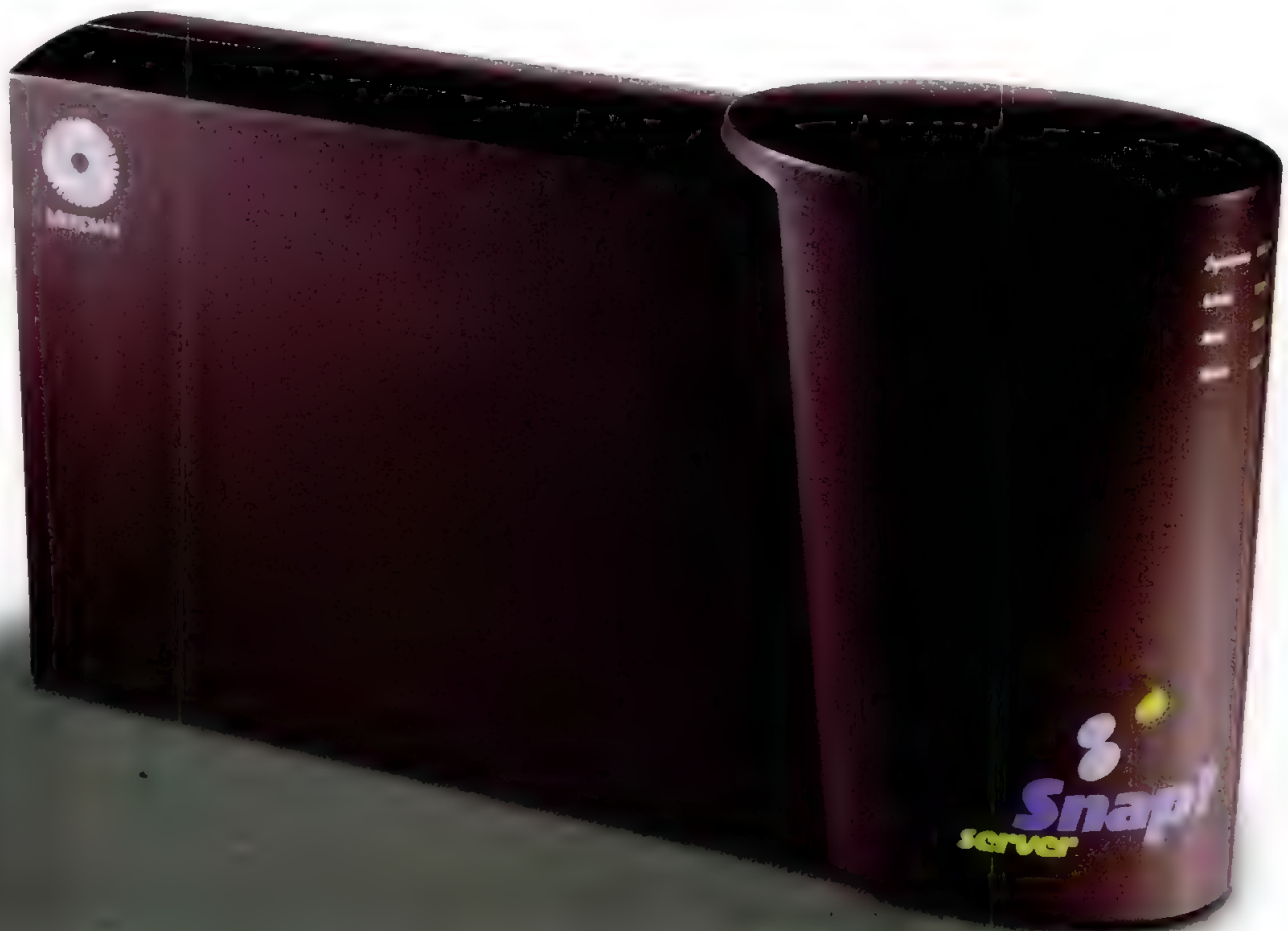
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which means you'll need more individual cards in each installation and additional chassis units in larger installations. The V/IP card and software are available for DOS 6, NetWare, and Windows 95. The V/IP GS8 we tested ran over Windows 95.

Micom's software lets you implement forward error correction (FEC), which statistically repairs dropped packets at the receiving end of the connection. Though this option increases the IP packets from 8 Kbps to 12 Kbps, our testing showed that it improved reliability significantly and word intelligibility slightly.

Micom provides central control for its V/IP gateways through LapLink Technical, which lets you manage them from any PC equipped with the LapLink program. Typically, you would control gateways across the IP network remotely, but LapLink has serial port and modem options, too. LapLink software is well proven and often familiar to network managers, so we liked this approach. SNMP reporting is also available.

Moreover, any designated V/IP gateway can act as a directory server. Each gateway periodically updates the directory server with phone numbers and IP addresses. Though the capability wasn't yet available in the products we tested, Micom's multiplexer units can recognize

fax tones and demodulate them for transmission as digital data.

Micom boasts a strong product line. If it fits your needs, you can buy or try these products with confidence.

Motorola Vanguard 6560

Starting price, \$4,248 list; tested configuration, \$13,300. Motorola Information Systems Group, Mansfield, MA; 800-663-7790, 508-261-4000; www.motorola.com/networking, 901 at www.pcmag.com/infolink.



Best known for its digital radio systems and cell phones, Motorola has made an art of digital voice technology. Its Vanguard family of VoIP gateways is similarly impressive in breadth and flexibility and carries price tags that are competitive with Micom's prices and well below those of NetSpeak. The Motorola systems are more mature than Micom's and provide every option that the vendor's reseller channels—including major telephone companies such as MCI—could want. You can set up these systems for voice over IP via frame relay

or for Token-Ring networking and ISDN, as well as a long list of PBX and telephone central-office connections. This flexibility, combined with Motorola quality and value, earns these systems an Editors' Choice.

We tested the Vanguard 6560 (\$13,300 list,



ALWAYS ON: Meant to be up continuously, the beefy Vanguard 6560 doesn't have an on/off switch.

configured for T1 lines), which is geared to central-site installations. It includes a stackable cabinet for more capacity, redundant power supplies for reliability, and even the highly reliable minus-48-volt power found in telephone central offices.

In addition, the family includes the Vanguard 6430 (\$2,799 list), designed for smaller installations, and the Vanguard 320 (\$2,519 list), which is pizza-box-size, equipped with four foreign-exchange lines, and targeted to branch offices. Motorola builds the devices to meet ISO 9001 standards; the result is a high level of quality and reliability.

Although Motorola delivered systems set up according to these standards for testing, its devices used considerably more bandwidth than the Micom or NetSpeak products. The voice quality was essentially comparable to Micom's. Our analysis shows that the higher bandwidth consumption was the result of Motorola's coding scheme, which delivers high reliability and would likely be most useful over the Internet. But these products are best suited to intranet connections. Over a well-managed intranet, the extra bandwidth requirement could drive up connection costs.

Like the NetSpeak models, the Vanguard 6560 was industrial-grade, with rack mounting and redundant cooling fans for easy scaling. Indicative of the system's design is the lack of an on/off switch; it was meant to run continuously. The Vanguard 6560 uses its 68060 processor running ONS (Open Networking

SUMMARY OF FEATURES

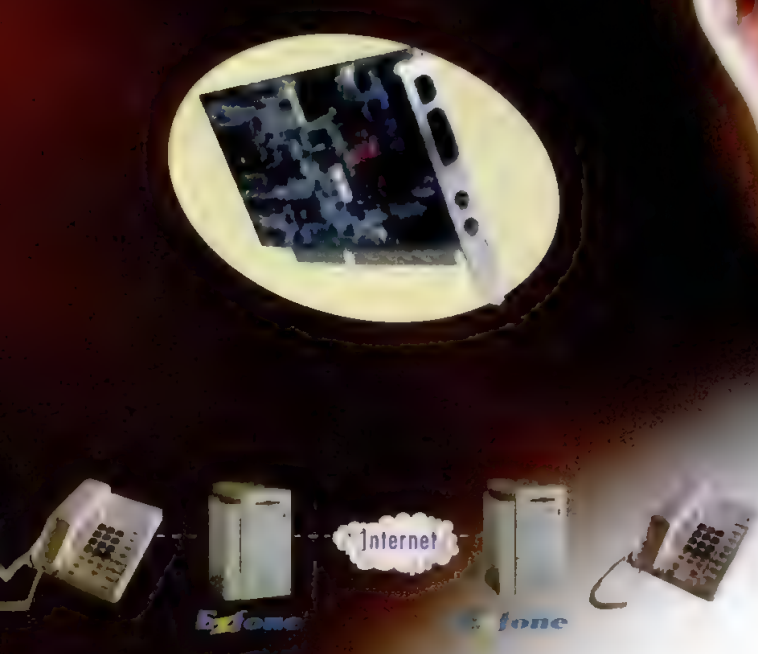
Voice over IP Gateways



	Micom V/IP Gateway System Model GS8	Motorola Vanguard 6560	NetSpeak WebPhone Gateway Exchange WGX/24 IPTT
■ YES ■ NO			
List price of tested configuration	\$11,985	\$13,200	\$39,600
Price per line of tested configuration	\$999	\$1,108	\$1,642
General			
Number of lines in tested configuration	12	12	24
Maximum number of T1 lines	1	1	4
Dimensions (HWD, in inches)	7.0 x 19.8 x 17.3	17.8 x 10.0 x 16.8	10.5 x 19.0 x 17.0
Rack-mountable	■	■	■
Operating system	Windows 95	Proprietary	Windows NT Server
Processor type	233-MHz Pentium	50-MHz 68060	200-MHz Pentium
Direct telephone connections	■	■	■
Adjusts compression to line quality	■	■	■
Provides call billing and accounting	■	■	■
Management			
Single-point management of multiple gateways	■	■	■
SNMP management and reporting	■	■	■
Dynamically maps phone numbers to IP addresses	■	■	■
ISO 9000-compliant	■	■	■
Technical-support hours	N/A	8:00-8:00 M-F; for contracted customers: 24 hours, 7 days	9:00-6:00 M-F, by pager, Sat., Sun
Technical-support number	N/A	800-544-0062	561-989-2300
Warranty	1 year	Hardware, 15 months; software, 90 days	90 days

N/A—Not applicable. Support for the Micom unit is provided by certified distributors.

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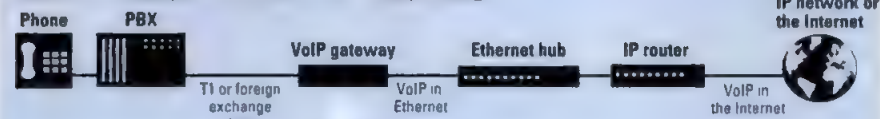
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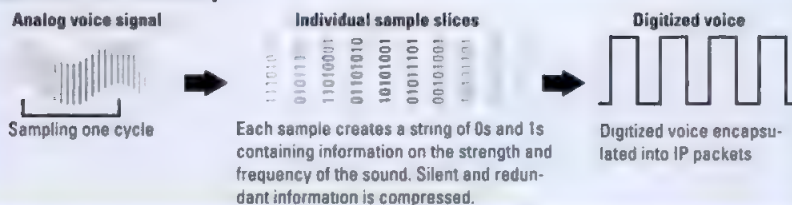
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How Voice over IP Works



Inside the VoIP Gateway



System) to handle management and communications chores. Each cabinet contains eight open slots for Motorola voice-processing and interface boards. The unit can support six T1 lines for a total of 144 voice channels.

Motorola provides two ways to manage gateways: through a terminal connection to a text script or through SNMP. Many technicians favor text scripts, because they can quickly implement standard or customized configurations using prepared text files. But

administrators in organizations with a big investment in SNMP will like the ability to manage the gateway systems from any SNMP console and to receive reports in MIB II format. Motorola, like Micom, offers faxing capability.

The Vanguard family is an excellent choice, either for a VoIP pilot program or for a fully deployed system. Motorola has strong VAR channels, a multitude of options, and robust hardware.

NetSpeak WebPhone Gateway Exchange WGX/24IPTT

Price: Tested configuration, \$39,400 list. NetSpeak Corp., Boca Raton, FL; 561-989-8700; www.netaspeak.com. 902 at www.pcmag.com/infolink.

● Unlike Micom or Motorola, NetSpeak Corp. has voice and multimedia over IP as its only business. If you've experimented with transmitting voice from a desktop PC, you've probably downloaded the company's WebPhone software or received it in a sound-card bundle. The NetSpeak WebPhone Gateway Exchange WGX/24IPTT is a highly scalable VoIP gateway aimed at both Internet/telephone service providers and business PBX markets. The NetSpeak system (\$39,400 list) spiked our price chart, though, as configured for one T1 line or 24 channels. Additional software programs can tack on as much as \$11,500 more. System integrators may offer scaled-down chassis alternatives for branch offices.

Also unlike Micom and Motorola, NetSpeak focuses on software and the tools required to build large VoIP systems. It is pushing ahead of the pack with account verification and credit-processing servers—part of a set of products and services called the

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Network Component Architecture.

The WGX/24IPTT is impressive in both its strength and simplicity. This is tough stuff: The commercial-grade chassis is designed for rack mounting and carries five fans. The hard disk, CD, and floppy disk drives are hidden beneath a heavy hinged cover. NetSpeak is in the process of obtaining ISO 9000 certifica-



TOUGH STUFF: All of the components in the rack-mountable WGX/24IPTT are extremely sturdy.

tion. The 20-slot ISA backplane hosts a system board with a 200-MHz Pentium processor that runs Microsoft Windows NT Server 4.0. You can load the cabinet to 96 lines with added T1 interfaces going to the PBX or a telephone company's central office, and you can scale the box up to 120 channels using E1 connections.

The product uses Natural Microsystems' Fusion telephone interface, voice-processing, and T1 interface cards. The cards carry voice data on a separate bus and don't burden the CPU. Our tests bore this out; the percentage of processor utilization never rose above a single digit with a dozen calls in progress.

Our performance tests showed that the WGX/24IPTT's voice quality was passable over a good connection but deteriorated under tougher conditions. The software was supposed to negotiate the use of the best voice processors for a given line, but it failed to do so. Though our jury testers re-

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VOICE OVER IP

ported that words were easy to understand, they also noted a particularly processed quality to the voice—clearly a result of

NetSpeak's economical use of the communications channel.

The gateway service automatically starts as a Windows NT process when you turn on the machine. The management program, Control Center, was easy to use and can run on any Windows 95, 98, or NT system. There are additional software components as well. The optional NetSpeak Information Server (IS) provides the translation between IP addresses and telephone numbers. This software runs on a dedicated system and costs \$2,500—plus \$375 per port. There's the Event Management Server (\$275 per port), which gathers call records and passes them to an ODBC database, and the automatic call distribution (ACD) function (giving you "push 1 to order..." menus), geared to ISPs entering the telephone market for a call service center linked to the Internet.

NetSpeak offers a scalable gateway system suited to large networks, but we found more confidence and value in the Motorola family of products. **PC**

connection, no catch.



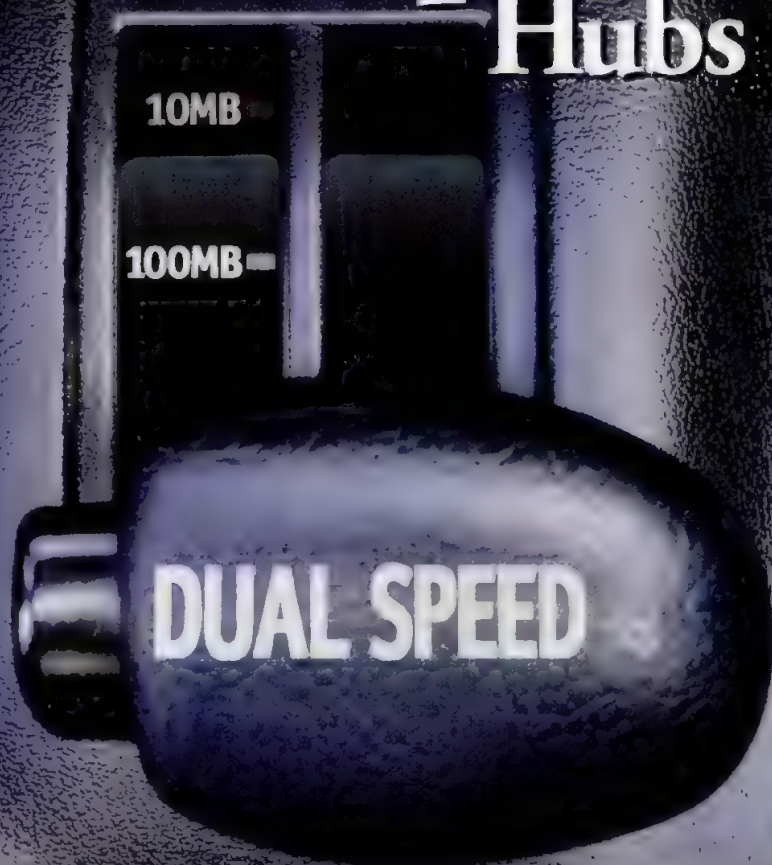
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Contest opens August 1, 1998. To enter, visit www.3com.com/makeover/pcmag2. Complete the online entry form and provide an essay of 500 words or less describing your ideal network makeover. Entries must be received by September 30, 1998 at 12:01 EST. Entries become the property of Sponsor and cannot be returned. Limit one entry per person. Winners will be notified by October 25, 1998. Open to legal residents of the 50 United States and Canada (excluding Quebec) 21 years of age or older, except employees and

resellers or consultants of 3Com, Microsoft, Micron, Ziff-Davis, their immediate families, respective affiliates, subsidiaries, agents, advertising agencies and Marden-Kane, Inc. A panel of 3Com judges will select a group of finalists, with the final judging to be determined by Marden-Kane, Inc. All decisions are final and binding. Prizes consist of: Three (3) Grand prizes of over \$30,000 in 3Com networking equipment, Microsoft software, Micron equipment, installation and support (not for resale) which will be awarded to the business indicated on the entry form. Total approximate retail value for the three grand prizes is not to exceed \$120,000. The author of each complete entry automatically receives a gift. Void where prohibited or restricted by law. To obtain complete official rules, send a self-addressed stamped envelope, before October 15, 1998, to: 3Com's Network Makeover Contest, P.O. Box 16216, Encino, CA 91416. Complete rules also appear on the web site listed above.

**Wrap it up!
Contest ends
September 30th!**

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Net Tools

FROM THE BENCH

NETWORKING KITS

The Plug-and-Play Network

By Steve Buehler

Peer-to-peer networking for USB-enabled computers is now as easy as plugging in a cable. The AnchorChip EZ-Link USB Network (\$89.95 list) is a proprietary cable system that lets you network two USB-capable PCs without opening their cases or sorting out protocols. Though it has limitations compared with Ethernet, EZ-Link is a good choice for

and voila—we had a network.

As with most SOHO networking kits, the EZ-Link handles file sharing via Windows Peer-to-Peer Networking. The kit defaults to NetBEUI, but you can change to IPX/SPX or TCP/IP via the Network applet in Control Panel.

We tested EZ-Link using our CATC USB Inspector equipment. Although it's slower than Ethernet, we found performance acceptable

for most file sharing or gaming needs. The USB bus has a maximum speed of 12 Mbps, but we obtained 2 Mbps. Bidirectional file transfers yielded a 4-Mbps throughput.

Though the EZ-Link beats Ethernet on ease of use, it is best for small, close networks. When scaling beyond two PCs, Ethernet is superior. Moreover, it doesn't require you to keep your PCs turned on to share devices.

AnchorChip EZ-Link USB Network. List price: \$89.95. AnchorChip Inc., San Diego; 619-613-7900; www.anchorchips.com. 910 at www.pcmag.com/infolink.



PLUG-AND-PLAY NETWORK: Making a network is as simple as plugging in a USB connector.

networking two computers and setting up ad hoc networks on the road, as well as for synchronizing your notebook and desktop PCs.

The EZ-Link package contains a proprietary 16-inch USB network cable, a 6.5-foot standard USB cable, and the EZ-Link software. This is sufficient to connect two USB-capable PCs into a network. You can replace the bundled cable with a 16.4-foot version (\$20 street) or add a USB hub (\$100 street) to increase the distance.

Our test network was up and running in less than 5 minutes. We installed the EZ-Link software on a Microsoft Windows 95 and a Windows 98 PC, entered the names of the networked PCs in a pop-up box, plugged in the USB cables—

DISK CLONING

Send In the Clones

By Arie Moller

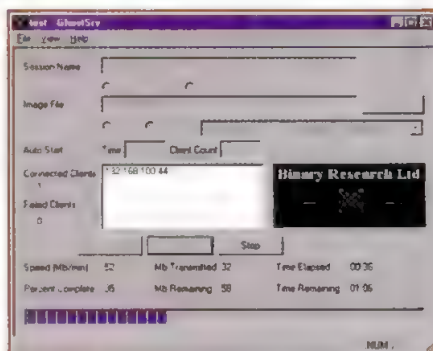
One of the more time-consuming tasks system administrators face is configuring multiple, identical systems. Disk cloning is a great way both to ease and to speed up this process. This method lets you make a copy of a source hard disk, transfer the contents of the disk onto each client, and then store the copy as a backup in case of drive failure.

Though disk cloning comes in both hardware and software flavors, hardware solutions have disadvantages. They require you to pull the hard disks physically out of the PC; you can only replicate as many disks simultaneously as the machine has physical connections; and you'll need separate devices for IDE and SCSI. And they're expensive, with hefty price tags in the thousands.

By contrast, software disk cloning involves making a compressed image file, or clone, of the PC's files and saving it to the server. You can then send it out to individual machines or to multiple client PCs at once (referred to as *multicasting*). The image will decompress, and a new set of files will be saved to the client's hard disk.

Symantec's Ghost Professional and Micro House's ImageCast Deluxe both provide complete solu-

tions including TCP/IP multicasting features, and both let you store cloned images on removable media, resize partitions, and perform compression. Because you need to assign each Windows NT client a unique Security Identifier (SID), both programs have methods to change SIDs in replicated clients.



SCARING UP CONTROLS: You can use either a Windows or a DOS client for administration.

Though both products did the job, we found Ghost to be more feature-rich, with much faster performance. It's also the only choice for Token-Ring networks. But ImageCast was easier to set up and use, and the \$795 unlimited license will appeal to your bottom line.

Ghost Professional

A recent acquisition of Symantec, Ghost Professional 5.0 (\$750 list) offers a boatload of flexible cloning options. Though this solution isn't as centralized or as easy to use as ImageCast Deluxe, it offers four cloning modes, Token-Ring support, and faster performance.

Ghost consists of the main program, the multicasting server, and Ghost Walker—the Windows NT SID editor. The program clones DOS, NetWare, OS/2, Unix, and Windows partitions and automatically resizes target partitions on the fly. It saves image files to most removable media as well and can span a client image over several pieces of media.

In addition to multicasting, Ghost offers three peer-to-peer

USB vs. Ethernet Networking

	USB (EZLink)	Ethernet
Price for two-PC network	\$90 list	\$100 street (with hub)
Setup time	5 minutes	1–2 hours
Requires opening PC case	No	Yes
Cost per additional PC	\$90 list	\$35 street
Maximum throughput	12 Mbps	10 Mbps
Tested throughput	2 Mbps	6–8 Mbps
Maximum distance between PCs	16.4 feet	640 feet
Print server support	No	Yes

cloning methods: local mode, LPT (parallel port), and NetBIOS. Local mode lets you restore an image saved on a local drive or connected resource. LPT transfer lets you restore PCs from image files stored on parallel-port removable devices such as an Iomega Zip Drive. Unlike ImageCast, Ghost doesn't require that you create boot disks to see network resources for standalone sessions.

Creating a multicasting session is more involved with Ghost than with ImageCast. You create a client boot disk by manually finding and copying the necessary files. Then you run the Windows- or DOS-based controller program at the server, specify a name for the session, and identify the target drive or partition for the clients. You can schedule the session to activate at a particular time or at a specific client count. Finally, you boot the client PCs that you want to receive the multicast and activate the session.

Ghost lets you multicast partitions, a useful feature that ImageCast lacks. But after the multicast,

Net Tools

FROM THE BENCH

you need to run Ghost Walker to change the PC's name and SID information.

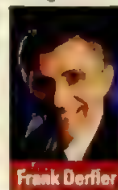
In testing, we pushed our 160MB image file from the client machine to our server in a speedy 2 minutes 46 seconds. Copying the image back onto a client took 2 minutes. But we found the processor on our 300-MHz Pentium II server hovered between 70 and 80 percent of utilization. Though this is high, multicasting is an after-hours task. We had no difficulty sending the image to 20 client machines simultaneously.

Ghost Professional 5.0. List price: \$750, plus \$3.50 to \$15 per seat up to 10,000. Requires: DOS 5.0, Microsoft Windows 3.x or later, or Windows NT; 4MB RAM (8MB for NTFS). Symantec Corp., Cupertino, CA; 800-441-7234, 408-253-9600; www.symantec.com. 911 at www.pcmag.com/infolink.

CROSS TALK



Frank, when we visited Symantec recently, the folks there were excited about acquiring Ghost. They see a lot of synergy between Ghost and their products. So when our readers consider the value of Ghost, they should look at it in light of Symantec's other products such as Norton Utilities.



These products are good for LAN manager's heads and bad for their waists, Toni. Like all TCO products, their direct benefit comes from reducing the walking around managers do. We'll continue to visit desktop management products because it's an area with a big payback for our readers.

ImageCast Deluxe

If ease of use and low cost are your primary concerns, Micro House's ImageCast Deluxe 2.12 (\$795 list for unlimited users) should be your disk-cloning choice. Though it was a slower performer and lacked Ghost's extensive options, ImageCast has a friendly, unified interface and helpful wizards that make the program a snap to use.

ImageCast handles the same range of OSs as Ghost, but it offers only two cloning modes (local and multicast) and can multicast only full disks. Like Ghost, ImageCast can save image files to removable media, but it can't span the image over multiple media.

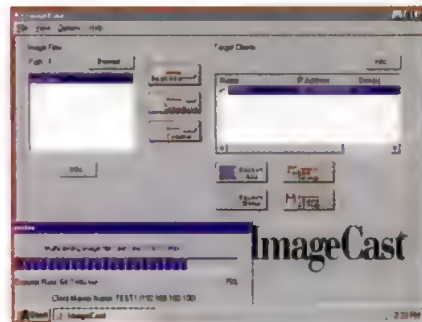
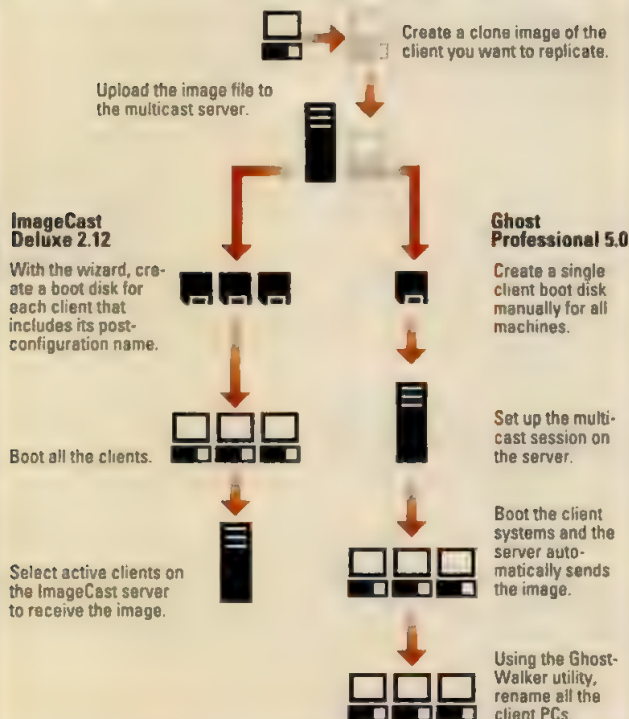
After an uneventful installation, we had access to ImageCast's two modules. The Client-Builder wizard walked us through creating bootable disks for our client machines. This was much easier to use than Ghost's manual method. In addition, Client-Builder can set up client disks with full postconfiguration information, which lets you build an individual boot disk for each client that will automatically rename the machines and set Windows NT SIDs.

All multicast scheduling is done using the ImageCast Controller module. Unlike Ghost, you first must boot each client machine in

the multicast session, then use Controller to discover the clients and deliver the image file. You can schedule the session to start at a particular time or after a set period, but not by the number of clients.

To test performance, we created a 160MB image file; ImageCast was able to transfer the host image to our server in 6 minutes 45 seconds. Although it took over twice as long as Ghost, ImageCast utilized only about half the processor power. But because multicasting is an after-hours task, CPU utilization is of less concern than speed. Delivering the image file to the client machines took about 2 minutes, and we pushed the image simultaneously to our 20 test-bed clients without incident.

How Multicast Disk Cloning Works



MULTICAST CENTER: The ImageCast controller directs all multicasting sessions.

ImageCast Deluxe 2.12. List price: Unlimited users, \$795. Requires: DOS 5.0, Microsoft Windows 3.x, or Windows NT, 4MB RAM. Micro House International, Boulder, CO; 800-926-8299, 303-443-3388; www.microhouse.com. 912 at www.pcmag.com/infolink.

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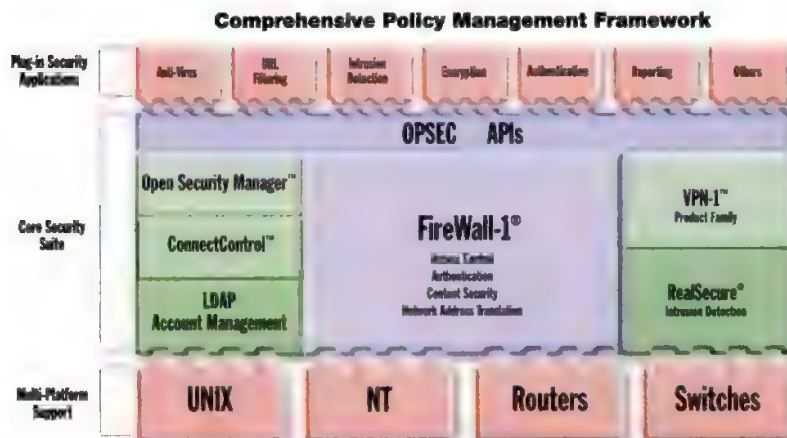
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CD-ROM SERVERS

Surf Your CDs

By Steve Rigney

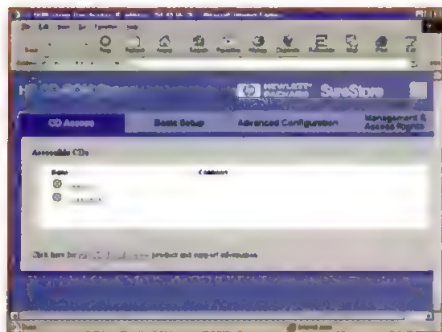
FOR many companies, a CD-ROM server is the most efficient way to share and distribute software. The HP SureStore CD-ROM Server/Tower (\$2,800 list) targets small businesses with

ernet and power cables, turned on the server, and inserted a CD. The SureStore shows up as a regular server on the network, with each bay appearing as a drive.

HP offers two administration methods. If you have a DHCP server, the SureStore will automatically lease an address for administering the server via a browser. You can also use the Address Resolution Protocol (ARP) to issue an IP address. The truly experienced can use a text editor to alter the server's Config.ini file; though confusing, this method is well documented.

Users have access to all titles by default. But the SureStore includes tight security options, relying on your existing Windows NT, NetWare, and Unix Network File Server (NFS) user groups for security access. You can restrict access to individual CDs, drive bays, or the entire server, and administrators can set parameters such as the number of simultaneous users and time-out periods.

HP SureStore CD-ROM Server/Tower. List price: \$2,800. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; www.hp.com/go/cdrom_server. 913 at www.pcmag.com/infolink.



WEB CD: Users can not only administer CDs from a browser interface but also access them.

more than 50 users. Along with a standard array of security options, the SureStore offers simple installation and intuitive, browser-based management.

The SureStore includes the server module, seven 32X CD-ROM drives, and an extra SCSI-2 interface to attach up to four additional drives. The unit provides an auto-sensing 10/100-Mbps Ethernet port and works with the IPX, NetBEUI, and TCP/IP protocols.

It took us longer to unpack the hardware than to get it up and running. We simply attached the Eth-

VIDEO DISTRIBUTION

Desktop Video

By Jan Ozer

How do you get high-quality video distribution across a corporate network without stressing bandwidth? Cisco has the answer: IP/TV 2.0 (\$6,500 list for 20 viewer licenses), a corporate video system that combines MPEG-1 video with multicasting technology. IP/TV lets you manage content and traffic across multiple servers, making it a scalable and efficient solution.

IP/TV handles real-time and disk-based video in both multicast or video-on-demand (VOD) mode. VOD lets any user access a video any time, and multicasting lets multiple viewers see the same video stream, conserving bandwidth. IP/TV has standards-based support for many video codecs, but not proprietary formats such as market-leader RealVideo.

The heart of the system is the Content Manager, which controls

Net Tools

FROM THE BENCH

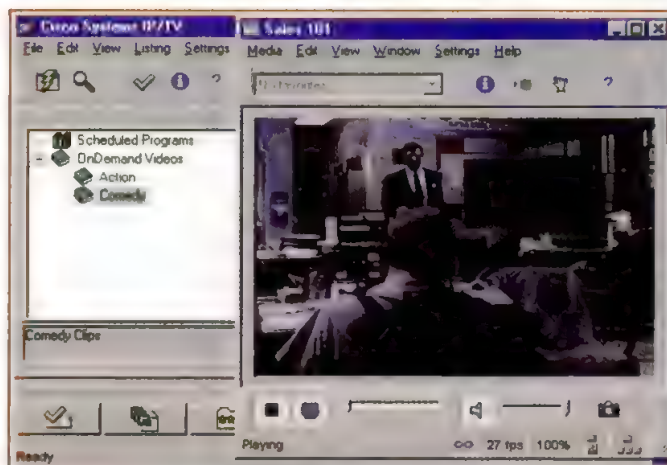
video distribution and content listings. You install it on a networked PC and manage it remotely through a simple browser interface. Content Manager gives you a host of easily accessed options. We were able to preserve bandwidth by limiting total video usage or multicast distribution and could protect all videos with passwords. We could schedule live or saved clips and play them once or at specified intervals.

The IP/TV Server, which con-

rectories, the programs need no further configuration.

Users view content through the IP/TV Viewer client, a standalone player or browser plug-in. The standalone viewer lets you search for scheduled videos and permits clients to send questions to the server during live multicasts. The embedded player has the same playback controls but offers no search or questioning capabilities.

During testing, we had five client PCs access two multicast streams and several on-demand clips. As expected, the multicast streams were extraordinarily efficient, with network utilization remaining at just over 10 percent of capacity.



I WANT MY IP/TV: The IP/TV Player lets you select both scheduled and on-demand selections.

trols the actual video playback, has comparatively few options. You just install it on the same server as your video files. If you put your video files in Cisco's default directory and install all the components in the suggested di-

IP/TV 2.0. List price: 20 Viewers, Content Manager, IP/TV Server, StreamWatch, \$6,500. Cisco Systems Inc., San Jose, CA; 800-553-6387, 408-526-4000; www.cisco.com/iptv. 914 at www.pcmag.com/infolink.

UTILITIES

NetWare Disk Tricks

By Steve Rigney

Most NetWare administrators can swap stories of long weekends spent upgrading the NOS or replacing hard disks. But PowerQuest's ServerMagic (\$495 list) aims to make those weekends a memory. The first product that lets you resize NetWare partitions on the fly and migrate the entire contents of

hard disks easily, ServerMagic is a must-have for your toolkit.

The utility runs as a NetWare Loadable Module (NLM) on any NetWare 3.x or later server. You access all the commands from the server's console using a character-based menu. NetWare administrators will find ServerMagic's menu easy to navigate, but before you begin, we recommend that

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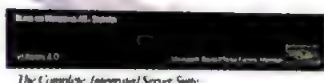
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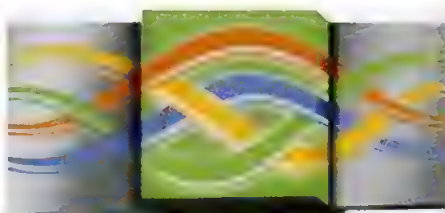
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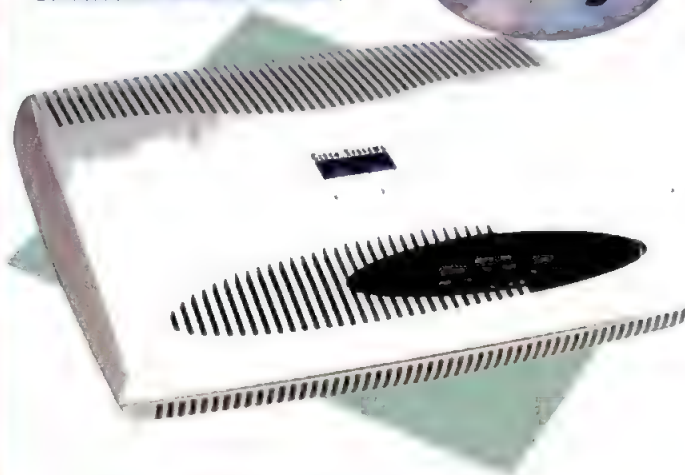
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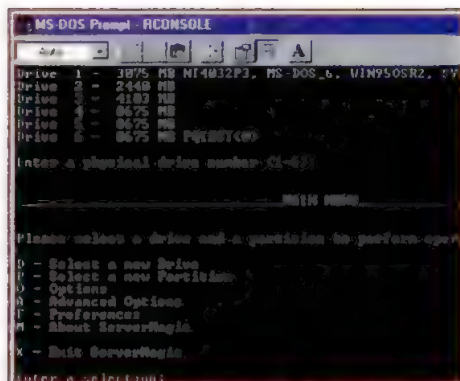


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CONTROL CENTER: You access ServerMagic's main menu from the server's system console.

you perform a thorough backup. Moreover, because the program requires you to dismount your NetWare volumes and disconnect all users, it's best used after hours.

In the past, resizing a partition could only be done by reformatting your server's hard disk. This was tough, especially when upgrading NetWare, because each new version required larger partitions. By contrast, ServerMagic lets you resize DOS and NetWare

partitions without rebooting. You can also borrow free space on a NetWare partition to add to a DOS partition (or vice versa).

ServerMagic lets you migrate the entire contents of your NetWare hard disk to a new drive. Although possible before, ServerMagic makes the task simple, and it

worked flawlessly for us. Rather than performing data backup, installing NetWare on a new server, and then restoring the data to that server, ServerMagic simply lets you copy the hard disks from the old server onto a new machine. **ServerMagic.** List price: \$495 per server; 3 servers, \$995. PowerQuest Corp., Orem, UT; 800-379-2566, 801-437-8900; www.powerquest.com. 915 at www.pcmag.com/infolink.

10/100 SWITCHES

An Easy Switch

By Martin Wong

As prices continue to tumble, adding an unmanaged switch to the LAN becomes an increasingly tempting proposition for the small business. The 16-port, 10/100-Mbps NetGear FS516 (\$1,650 list) is just over \$100 per port and addresses an

important concern for this market: ease of use.

During setup, there's only one configuration choice to make: whether to set the switch's ports to auto-sense network speed or to force them into full duplex using the DIP switches on the back. You can use the sixteenth port as an



SWITCHING ON THE CHEAP: The FS516 provides a low-cost unmanaged switch for networks.

Net Tools

FROM THE BENCH

uplink. Unlike some switches, the FS516 can additionally handle large networks without any configuration. NetGear backs up the switch with a five-year warranty, as well as free round-the-clock lifetime technical support.

The switch performed well, displaying low latency. It handled moderate traffic levels without losing packets. With an 80 percent load, the FS516 dropped only a small number of packets and should handle roughly 11 ports at full duplex when fully loaded.

Though its performance is similar to the eight-port NetGear FS508, there are some differences. The FS516 exclusively uses *store-and-forward*: The unit waits to receive an entire packet before forwarding it. The FS508 uses a combination of *store-and-forward* and *cut through*, whereby it begins forwarding packets before receiving an entire message. Though slower than cut through in low traffic, store-and-forward reduces errors in a high-traffic network.

NetGear FS516. List price: \$1,650. NetGear Inc., San Jose, CA; 888-638-4327, 408-988-2400; netgear.baynetworks.com. 916 at www.pcmag.com/infolink.

UTILITIES

Commanding NetWare

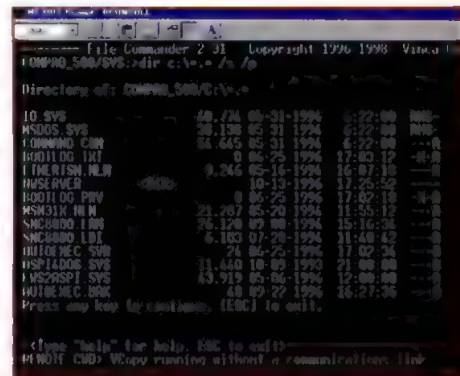
By Steve Rigney

A handy utility for any NetWare administrator, Vinca's File Commander (\$199 list per server) is the only program we've found that lets you copy, move, edit, and compare files located on DOS and NetWare partitions while the server is running and without disconnecting users.

You can download File Commander from Vinca's Web site. The program also requires that you install File Commander's NetWare Loadable Module (NLM) onto each server you wish to manage as well as one of two additional NLMs,

NetWare 4.11 server was designated master, and the others were slaves. Then, we easily copied the contents of our server's hard disk to subdirectories available on the other two servers.

If you're familiar with DOS, Vinca's command-line interface



SERVER CATALOG: Vinca's File Commander can show you all the files on a server partition.

depending on whether you run the server in master or slave mode. The master server can edit, delete, move, and copy all of the files on any slave server; slave servers can modify only the master. You can also edit a server's Autoexec.ncf file remotely, letting you automatically load NLMs at start-up.

We installed File Commander on three servers running NetWare 3.12, 4.1, and 4.11, respectively; the

will be intuitive. For help, typing a single command will give you a list of all available options. We especially liked the product's ability to list NLMs as well as any associated files they need to run.

File Commander. List price: \$199 per server; \$1,399 per site license; \$4,999 for unlimited users. Vinca Corp., Orem, UT; 800-934-9530, 801-223-3100; www.vinca.com. 917 at www.pcmag.com/infolink.

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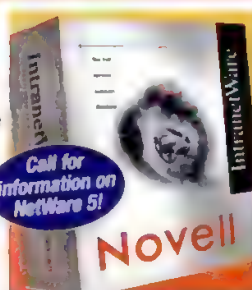


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PC Tech



Visual Basic Grows Up

Once a general-purpose tool, VB now has advanced database and Internet capabilities aimed squarely at the enterprise market.

By Will Fastie

Microsoft seems to have been focused almost exclusively on the Internet for the last few years, a focus that has finally found its way into Visual Basic. With Version 6.0, Microsoft has equipped its best-selling programming language with a host of features that let you build Web-based applications. This functionality, though available with additions to VB5, is much more integrated in VB6, and much richer.

In keeping with the company's push to the Web, Microsoft's emphasis this time around is almost exclusively on VB6's Internet features and advanced database capabilities, and as a result, on the Enterprise Edition of the product. This is much different from previous versions of VB where the emphasis was always on improvements to the core of the product—the language, the supplied components, and the integrated development environment (IDE). Al-

most all such improvements showed up in the Professional Edition, making it the meat-and-potatoes edition of Visual Basic and giving it broad market appeal.

If VB6/Pro's enhancements relating to the Web are set aside, the improvements to VB6 over VB5 are not as compelling as those that have gone before. (Perhaps we are just spoiled.) VB3 was a major leap over VB2, catapulting the product into the ranks of serious programming tools and dramatically expanding its market. VB4 was tremendously enhanced and brought us the means to make the transition from 16- to 32-bit Windows. VB5 had many enhancements, noticeable performance gains, and the long-awaited native-code compiler.

VB6 does bring some substantial core improvements, to be sure. Nonetheless, it brings quite a bit of aggravation as well. Price is the first example. Across the board, VB6 costs about 10 percent more than VB5. For example, a new copy

www.pcmag.com/pctech

You'll find all of the articles, examples, and code files in this section at PC Tech Online.

INSIDE

TUTOR: Software makers don't just guess how users interact with their products; they watch. Major vendors have set up sophisticated usability labs to collect hard data on what works, what doesn't, and what makes people pull out their hair. *Page 285.*

POWER PROGRAMMING: JavaBeans are reusable components, which allow programmers to get more done without repeating their efforts. We walk through the process of creating a simple JavaBean to show you how it's done. *Page 293.*



UTILITIES:

Nautical Flags is a fully functional 32-bit Windows screen saver that displays a random assortment of the standard signal flags and pennants used aboard ships to spell out messages. *Page 303.*



PC SOLUTIONS: Changing the default action for batch files; protecting shortcuts to programs on removable drives; troubleshooting a CD-audio problem; extracting addresses from Internet Explorer 3's Address Book; converting JPEG or GIF files to bitmaps; changing default find behavior in Excel 97; and more. *Page 319.*

of VB6/Pro costs \$50 more than VB5: \$549 versus \$499 (list). However, the VB6/Pro upgrade, which will be the biggest seller, costs 15 percent more: \$229 as opposed to VB5/Pro's \$199. And it's even worse—the list price of the upgrade is actually \$279. You have to return one of those annoying rebate coupons to get your 50 bucks back. To be fair, the price of VB has been rising steadily for many years, but we're a pretty far jump from the \$80 street price for the VB3/Pro upgrade.

While we're on the subject, we should emphasize the reality of Visual Basic. Version to version upgrades have traditionally created transition problems for developers. There is always something that has to be tweaked in the code or adjusted in the environment to get a VB project to run properly in the newer version. Skipping a VB version exacerbates the problem by doubling the number of upgrade issues. So for anyone working with VB on a regular or professional basis, keeping up with version upgrades should be a matter of course. As one of the huge mass of VB programmers, you simply have to pay the price to keep up with Microsoft's VB success.

Let's look at the Internet features in VB6 first, then turn to the core of this new version.

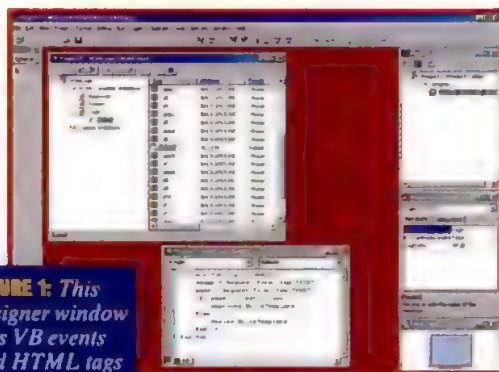


FIGURE 1: This designer window lists VB events and HTML tags from an associated page.

INTERNET SUPPORT

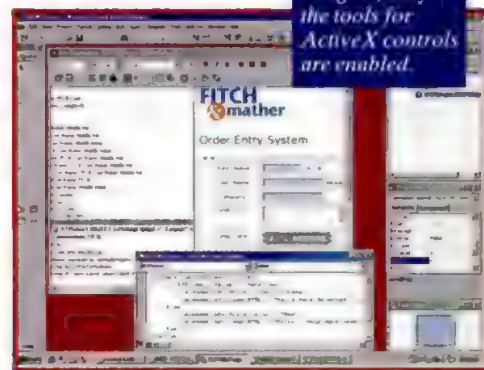
In true Microsoft fashion, the demonstration of VB6's Internet features is spectacular. We were able to build the examples provided as part of the VB6 Reviewer's Guide in less than 15 minutes, and the results were impressive.

As the Wizard of Oz said, "Pay no attention to the man behind the curtain." Microsoft's examples were quick and easy, because the more difficult part of constructing the actual Web pages involved in the projects (plus some components of the projects themselves) had already been done. The process is to construct Web pages using Microsoft Visual InterDev or some other tool, then use VB to connect VB event code or ActiveX controls to those Web

pages. In other words, all the work can't happen within VB alone. This is in sharp contrast to a development tool like TopSpeed's Clarion, in which a complete application can be converted into interactive Web pages with one click of the mouse. VB takes a component-based approach: Given the HTML for the Web pages, you build VB components to connect to them.

There are two methods for building Web-based VB applications, both represented as new VB application types. One uses the new Web-Class object model to create an Internet Information Server (IIS)-based application. The other provides a means to connect VB code to ActiveX control objects within the Dynamic HTML (DHTML) object model. Both methods have some Microsoft-specific aspects. IIS is a Microsoft product, included as part of Windows NT Server. IIS-based VB applications will therefore run on any Web server powered by NT. DHTML is not an Internet standard, at least not yet, so this approach requires the user to browse such Web pages with Microsoft's own Internet Explorer (IE) Version 4.01.

FIGURE 2: In this application designer, only the tools for ActiveX controls are enabled.



To begin an IIS-based application, you select *IIS Application* from the *New Project* dialog. For the simple Reviewer's Guide example, Figure 1 shows the "designer" used to create the application. The *Approved*, *Denied*, and *Login* entries are HTML pages created outside VB. Under *Login*, a *Submit* event has been created that collects the log-in information entered by the user viewing the Web page and then switches to either the *Approved* or *Denied* Web page as appropriate. The right pane of the designer shows all the HTML tags from the associated Web page, including the *Submit* button. VB updates the Web page to connect the *Submit* button to the event-handling code. Testing of this application is integrated; pressing the F5 key to run this application launches IE4 and displays the associated Web page.

To begin a DHTML application, you select *DHTML Application* from the *New Project* dialog. For the Reviewer's Guide example, Figure 2 shows the designer used to create the applica-

VB for the Enterprise

When Microsoft tags an edition of a product "Enterprise," it means that the product comes with components and features that support the development of client/server applications. Microsoft Visual Basic 6 Enterprise Edition is no different. Most of its features fall into one of three categories: database, Internet, or team development. The database and Internet features provide access to or tools for the server side.

Database support includes OLE interfaces for OLE DB, Remote Data control for data access via Remote Data Object (RDO), a debugger for SQL, Microsoft SQL Server 6.5 support, a SQL stored procedures editor, and visual database tools.

Internet support includes Microsoft Internet Information Server 4.0 (IIS), which facilitates connections with Microsoft's BackOffice products, and the Microsoft Transaction Server (MTS), which provides transaction-processing support for Internet and intranet applications. MTS also supports traditional WAN- or LAN-based distributed applications.

Team development support includes the Visual Component Manager, a tool for organizing the various VB components you develop, and Visual SourceSafe, Microsoft's configuration management tool.

If you are responsible for significant work on the server side of applications or make heavy use of one of the mainstream relational databases such as SQL Server or Oracle, VB6/Enterprise is a must. If you mostly do client work, have minimal server needs, or work alone or in very small groups, you'll probably find VB6/Pro adequate for your needs.

A new copy of the Enterprise Edition costs \$1,299; an upgrade, \$759. These numbers are probably palatable for organizations with a mix of developers, some using Microsoft Visual Studio and some using just Visual Basic. For the latter group, buying just VB is less expensive than equipping them with Visual Studio. Despite that logic, a quick check with a few large companies and consulting houses revealed that Visual Studio Enterprise Edition is purchased for every developer seat because volume pricing makes it attractive.

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POWER

tion. In this example, Microsoft's new DateTimePicker ActiveX control has been placed on the order entry form next to the label "Ship Date." This was accomplished by dragging the control from the ToolBox to the Web page displayed in the right pane of the designer. Code has been added to the Click event of the DateTimePicker to display a text message confirming the validity of the selected date. The left pane of the designer shows the components that make up the DHTML page, including the DateTimePicker control we added. Testing of this application is integrated as in the IIS application.

In Figure 2, notice that most controls in the ToolBox are disabled. This is because the basic controls provided with VB are not ActiveX controls but hard-coded VB controls. Only ActiveX controls will work with a DHTML application, so only those controls are available here.

Despite the ease with which we completed the examples, this type of development is not as easy as Microsoft would have us believe. You must understand the concepts underlying Web pages and have some familiarity with HTML. You must be able to visualize the relationship between the information provided by the designer and the previously created Web pages. You must understand the VB object model for IIS and DHTML applications. And, of course, you must be able to construct the Web pages that you want to connect to VB code. Microsoft has done a good job integrating the designers into the VB IDE, so at least some of the work is visual rather than code-oriented. You will have to study the trees in the left pane of the designers to understand what they mean. In short, the brevity of our description here belies the underlying complexity of VB-based Internet application development.

We've mentioned the concept of *designers* in discussing the Internet features of VB6. Designers are new Visual Basic components that can be included in a project along with forms, MDI forms, modules, class modules, and so forth. As shown in Figure 3, designers are not generalized. Only the designers provided by Microsoft can be added to a project. Microsoft provides four: DHTML, WebClass (for IIS apps), DataReport, and DataEnvironment. We'll talk more about the two data designers shortly.

THE CORE

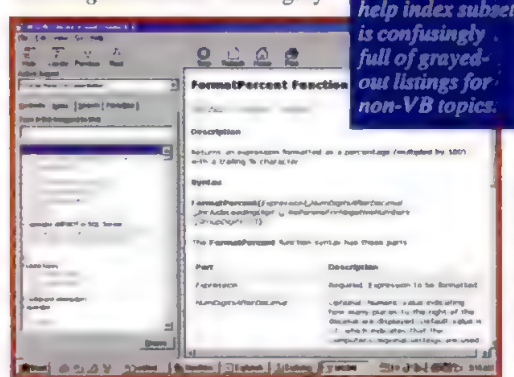
VB6/Pro comes on three CDs. One contains VB itself, and the other two contain the Visual Studio edition of MSDN (Microsoft Development

oper Network). The MSDN CDs are important, because they contain all the help files.

The installation process has become more cumbersome. There are more steps, with several system restarts along the way. VB6 is installed first, followed by MSDN. Finally, you are offered the option of installing various services, such

as the Microsoft FrontPage 98 server extensions. It's hard to measure how much disk space is used, because the components are placed in various folders, but expect a typical installation to consume between 100MB and 150MB of disk space. Setup takes about 20 minutes. It has become common practice for newer versions of Visual Studio products to suggest removal of previous versions; if you accept this suggestion, setup time will increase. Although Microsoft is nervous about VB6 living on the same system with earlier versions, we had the Pro editions of VB4, VB5, and VB6 on the same computer and noticed no problems.

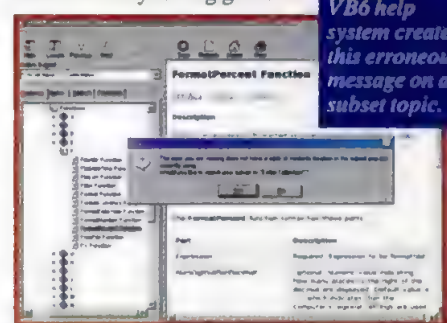
As you can see in Figures 1 and 2, the IDE is unchanged from VB5. There are two new menu items, *Query* and *Diagram*, which provide more direct control over the construction and maintenance of database queries as well as the design and diagramming of the databases themselves. These are welcome additions to the IDE. However, *Query* and *Diagram* are only active when the data connection is to a database server such as SQL Server, DB2, Sybase, or Oracle. For Jet applications (common among VB developers), the *Query* and *Diagram* menus remain gray.



A big change is the switch from WinHelp to HTMLHelp, although it's not for the better. The quality of VB help began declining in VB4 with fewer examples, and continued in VB5 with the linking of multiple help files. Both versions showed a growing number of broken hyperlinks. All these problems are present in VB6.

The trend toward fewer examples is a terrible one for the average programmer. VB originally distinguished itself by including examples for just about everything, thus giving valuable insights to those new to VB and those struggling with new features. And though it's true that many advanced features of VB are difficult to represent in a brief example, examples for the simpler things are often just as valuable but are increasingly missing.

The links between multiple help files sounds like a good idea on the surface but is awful in practice. The problem is a loss of context. For example, if you have VB5 and Microsoft Office installed on the same system, navigation within the VB5 help files may lead you into the MS Access help files. The only saving grace is



that you can tell which help file you're in when you're using WinHelp. The new HTMLHelp changes that. With VB6, you're browsing the entire Visual Studio help suite—over 800MB of information. You can't tell one help page from another, so following a link from a VB topic, which you would naturally think would lead to further VB information, can land you in a topic related by name but having nothing to do with VB.

Our favorite example of this is searching help to find out how to programmatically obtain the version of Visual Basic. In point of fact, there is no VB syntax to do this. However, following links can land you at an example called *Version Property Example*. There you will find the statement `Debug.Print Application.VBE.Version`. Sounds pretty good, but it turns out that this syntax is specific to Visual Basic for Applications (VBA) and is used to determine the version of the VBA host (MS Word for example). You get absolutely no clue that this is not a VB6 topic.

The inclusion of the complete Visual Studio help actually just gets in the way of someone focusing on VB. Microsoft has tried to deal with this by creating subsets of information. A subset can be selected easily from a combo box; one such subset is called *Visual*

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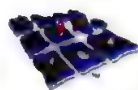
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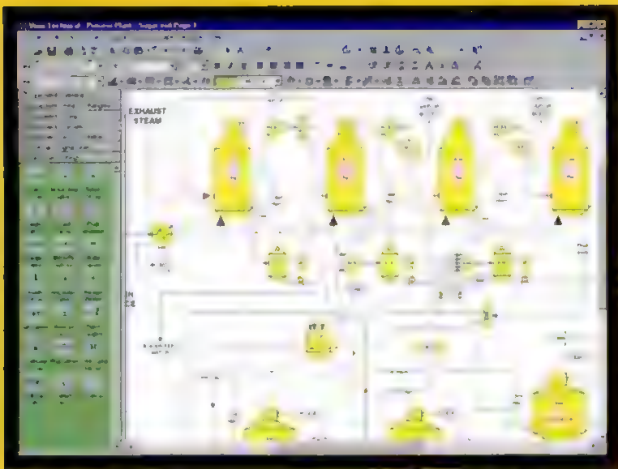
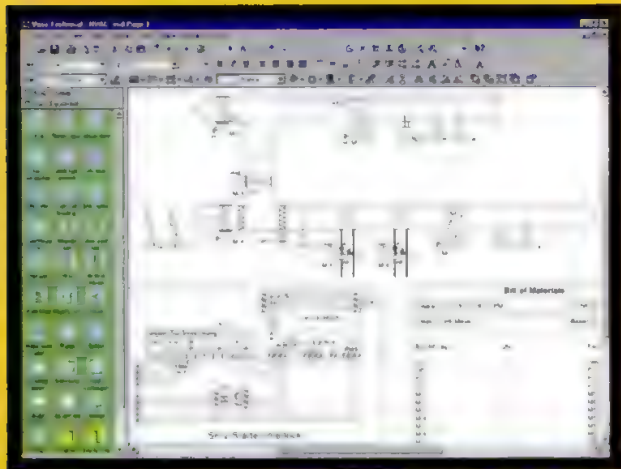
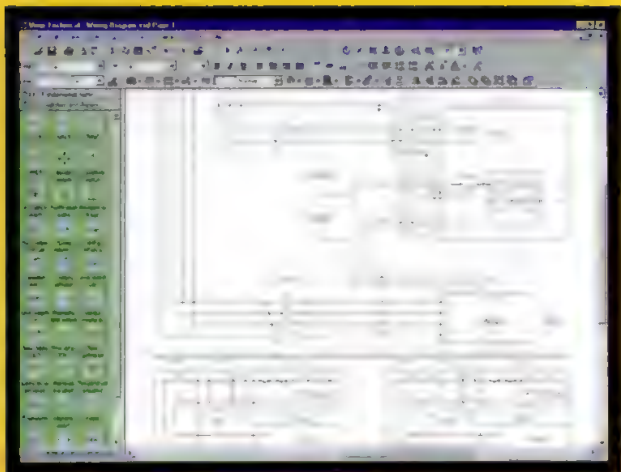
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Basic Documentation. Selecting a subset changes the index so that items not related to VB are grayed (Figure 4), thus highlighting VB-specific information. A better idea would be to simply hide the non-VB items, because the index containing entries for all of Visual Studio is huge. The display turns into a vast wasteland of gray, punctuated by an occasional VB topic. Subsets also have other peculiar problems, as illustrated by Figure 5. Here the help system claims that the VB topic being displayed isn't in the table of contents for the VB subset, despite the fact that both are visible.

The problem of broken links has been growing as the help files have grown from version to version. Now, with everything in the one Visual Studio pot, the situation is worse. When links are broken, it's not obvious how to find the information in other ways. You could search for hours yet never find the page to which the broken link was supposed to point.

If you think we are harping on the help system, keep in mind that VB does not come with printed manuals any more. They are a separate, high-priced item. Microsoft intends the provided electronic documentation to be your primary source of information. That's okay with us as long as it's quality documentation—comprehensive, complete, and collected.

One good feature, first seen in VB5 but rarely mentioned in the press, is the context-sensitive help available from the object browser. Most VB users are familiar with right-clicking on a name in source code and selecting the *Definition* option. For variables and functions defined by the user, this action switches the view to the variable or function definition. For keywords or intrinsics, VB5 and VB6 launch the VB Object Browser, which shows the class membership and syntax of the item (see Figure 6). A right click at that point brings up another menu, which includes a link to the help file. Many users don't realize that help is just another click away.

VB5 TO VB6 CONVERSION

In every VB version transition, there have been some changes that forced developers to work to switch a project to the new version. In the past, this involved such source-code-altering transformations as changes to controls, VB syntax, and certain methods. The

good news is that we found no such gotchas in the transition from VB5 to VB6. In fact, once we smoothed over the big problem in the VB6 transition (see below), we were able to convert, compile, and run ten small applets and two larger production systems with no changes to any application code. This is the first time we have ever been able to do this, a major improvement.

The big problem is one that was present in the transition from VB4 to VB5, so we were genuinely annoyed to find it again this time around. If you used any of Microsoft's Windows common controls in your VB5 application, such as ToolBars, ImageLists, or StatusBars, you must take care in the transition.

These controls and others are contained in the COMCTL32.OCX and COMCT232.OCX DLL files for VB5. For VB6, they are in COMCTL.OCX, COMCTL2.OCX, and COMCT332.OCX. Whenever a control is registered with Windows, something called a Globally Unique Identifier (GUID) is assigned. If you look at a VB project file with a text editor, you will see that OCX files are not referred to by their names but rather by their

GUIDs, a long sequence of hexadecimal digits with a few hyphens here and there. The GUIDs for the VB5 version of the Windows common controls and the VB6 version are different, which creates the problem.

As long as you continue to use the

VB5 controls when you convert your project to VB6, you're safe. It's when you attempt to convert that you'll have a problem. VB5 asked if you wanted to update to the new version when converting a VB4 project. If you clicked Yes, all your Windows common controls turned into Picture Boxes, because VB could not connect the GUIDs of the older controls to their newer versions. Our beta copy of VB6 asked the same question and behaved in the same way, but Microsoft says that the production version will not. Instead, Microsoft will provide a small program (itself written in VB) that scans a VB5 project and makes the GUID changes. You run this converter *before* you load the project into

VB6 for the first time. We tested a beta version of the converter, which has not been named, and it worked perfectly. Microsoft plans, but did not promise, to have this converter on the VB Web site by the time VB ships, so it should be there by the time you read this.

Despite the existence of this problem between VB4 and VB5, Microsoft didn't catch it until late in the VB6 beta process. Hopefully this conversion will be an automated part of loading a VB6 project into VB7 sometime in the future, or if we're really lucky, a Service Pack fix.

PERFORMANCE

Every version of Visual Basic has brought performance enhancements. Microsoft identifies several areas of VB6 in which performance has improved.

Microsoft claims that data access has improved as a result of "improved database drivers and data access components." We examined two production applications based on Jet (DAO) and noticed no obvious improvement. Given Microsoft's clear interest in connectivity to database engines such as Oracle and its own SQL Server, however, we suspect that much of the improvement lies there though we did not test such connections for this article.

Microsoft again claims to have improved forms handling, particularly the loading of forms. There was a visible improvement in VB5, one of the most compelling reasons to upgrade (even more so than the native code compiler). We did not notice the improvement in VB6; larger, more complex forms can still be sluggish.

We compared the time it took the same system to load VB6 and a project against the time it took to load VB5 and the same project. VB6 seemed slightly slower, though this performance downtick will vanish given today's rapid increase in processor performance.

One area in which VB6 improved is string handling, long a sore spot with VB programmers. VB6 includes a rather long list of new string functions designed to speed up common string operations. Some of these seem to be based on the kind of programming Microsoft does rather than what the broader VB programming community does day in and day out. An example is the `Split` function, which takes a string and parses it into words, phrases, or substrings based on a given delimiter. `Split` sounds great for compiler writers

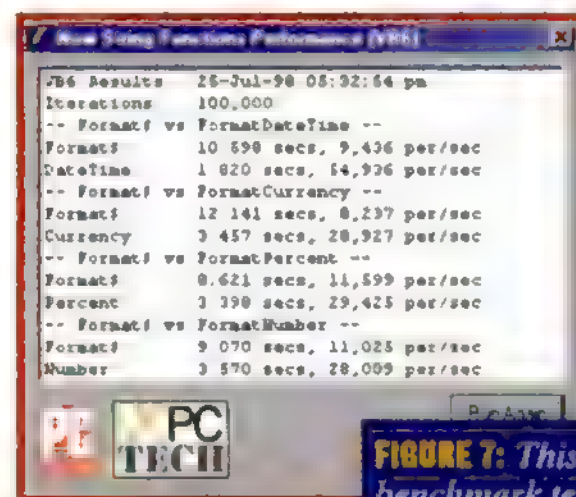


FIGURE 7: This benchmark test applet compares the results of two kinds of function calls.

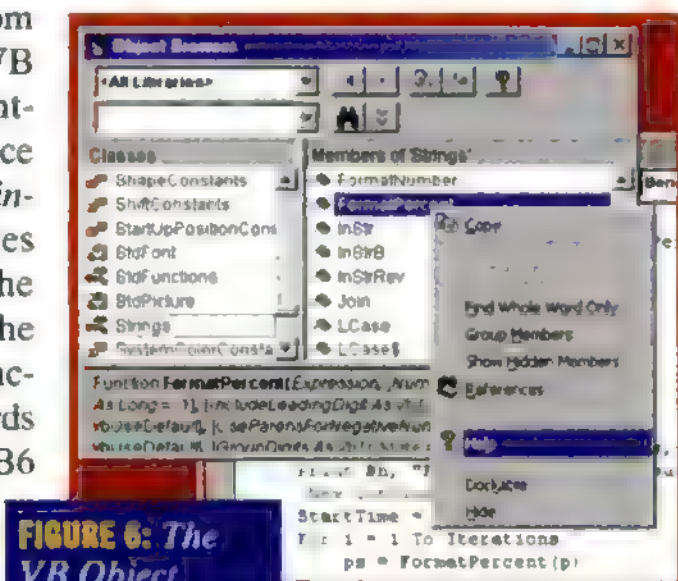


FIGURE 6: The VB Object Browser shows an item's class membership and syntax.



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or systems programmers, but less interesting for business application programmers. The `Filter`, `Join`, and `StrReverse` functions fall into the same category. We do welcome the `InstrRev` function, which searches for substrings from the end of the string back, because it is useful in parsing pathnames, a common task. We also welcome the horribly overdue `Round` function, though we question its inclusion in a list of string functions. (Round can accept a string as its argument if the string can be interpreted as a number.)

Perhaps the most heavily used string function is `Format$`, which can convert almost any kind of value into almost any formatted string. Because of its general purpose nature, this function is slow. VB6 includes specialized versions for the most commonly used formatting tasks: `FormatDateTime`, `FormatCurrency`, `FormatPercent`, and `FormatNumber`. The key differences between these functions and `Format$` is that they know in advance what kind of value they are dealing with, and they don't have to parse a format string to figure out what the output format looks like. The elimination of the format string probably contributes most of the savings. Dedicated functions like these, based on `Format$`, are already part of most professional programmers' libraries, but the inclusion of intrinsic functions is good.

And how! We wrote a simple test program to compare the two kinds of function calls. The applet is shown in Figure 7, which also shows the results. The new functions are from two to five times as fast, a dramatic improvement.

We were curious to learn if the basic string-handling intrinsics—such as `Mid$` and the concatenation operator `&`—also got faster. Improving these functions makes every program faster without requiring coding changes. So we also wrote a small benchmark test applet, shown in Figure 8. There is a version of this applet for VB5 and one for VB6; each version shows the other's results. To our dismay, we noted slight degradations in almost all the tested functions under VB6. The variations are slight, and we were concerned about the rough timing provided by VB's `Timer` function. However, repeated runs of the test returned consistent results. (Both benchmark tests mentioned can be downloaded from *PC Magazine's* Web site.)

To be fair, all the string functions were made faster with the compiler introduced in

VB5. It's sad to give even a fraction of that back, though, especially because other products (especially Inprise's Delphi) have much faster string handling.

DATA HANDLING

On the whole, data management shows great improvement in VB6. Earlier we mentioned two new designers: `Data Environment` and `Data Report`. Though VB allows you to start a new project called a *Data Project*, and though Microsoft's samples are all *Data Projects*, the two designers can be used with a standard VB project.

Figure 9 shows a `Data Environment` designer in action. The designer shows each of the connections (data sources) available to the project and the specific elements used in that connection. In addition, the `Data Environment` can show the relationship between those elements. The `Data View` to the right of the screen, launched by clicking the *Data View Window* toolbar button, shows what the connection has to offer. Tables from that view were simply dragged to the designer. Once there, you can examine and modify the tables' property pages, including a *Relation* tab that describes how one table relates to another. In this case, *Orders* are related to *Customers* and *Order Details* are related to *Orders*, a hierarchical view that is evident in the designer.

The form for this simple project was completed with one drag-and-drop operation. We simply dragged the *Customer* name and dropped it on the form. The designer dropped in fields for all the customer elements, plus an `MSFlexGrid` for the *Orders* and *Details*. Running the application at this point yields a working result, though adding navigation controls is necessary to actually move beyond the first customer record.

A `Data Report` designer is shown in the lower-right corner of Figure 9. With its traditional banded style, the purpose of this designer should be immediately apparent. Indeed, the `Data Report` is a Microsoft

Access-like report generator. The designer is relatively easy to use and relatively intuitive.

The presence of a Microsoft report generator in VB is long overdue. Although Seagate's *Crystal Reports* is a fine product, the version that traditionally came with VB was at least one iteration old. Seagate's main interest was in encouraging VB users to upgrade to the company's full product. We hope the `Data Report` can become a key part of the VB environment and expand to more fully fill the role of default reporting system. For the moment the designer probably won't, given Microsoft's tendency to take a couple of versions to get a product right. As for *Crystal Reports*, it's still in the box. This time, however, it hasn't been upgraded along with VB—the same version (4.6) is included that came with VB5.

What started out as a VB sample program several versions ago has become a part of the VB environment. The `Visual Data Manager` (*VisData*) provides a surface to look at the databases that are a part of your application. *VisData*, as just a viewing and querying surface, is much lighter than *Access* and much more convenient to use, especially because it occupies the first entry on the *Add-Ins* menu within VB6. *VisData* remains a sample, with the source code in the VB6 samples folder on the CD. *VisData* has some Jet-specific features, such as *Compact* and *Repair*, so it can be a useful utility at client sites where *Access* is not

licensed. You can also integrate *VisData* or just portions of it into your own application.

A NEW ERA?

Visual Basic came into life as a tool designed to make it easy for a broader audience to create Windows ap-

plications. With each new version, VB has grown bigger and more complex. VB6 continues this trend with advanced database tools and Internet capabilities that indicate the product's future lies in the enterprise—a new era indeed for a once simple product. **Visual Basic 6.0 Professional Edition.** List price: \$549; upgrade, \$229 (with rebate coupon); upgrade from VB3 or earlier, \$279. Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com/vbasic. 551 at www.pcmag.com/infolink. 

Will Fastie is an independent consultant located in Baltimore, MD.

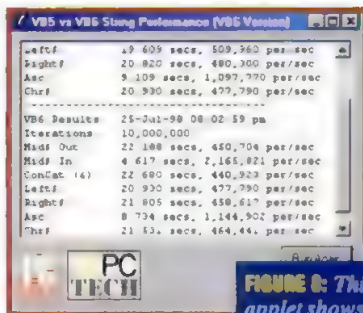


FIGURE 8: This applet shows that some string-handling functions are a bit slower in VB6.

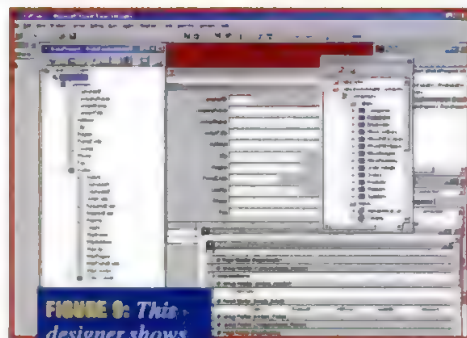


FIGURE 9: This designer shows each of the data sources available and the elements used.

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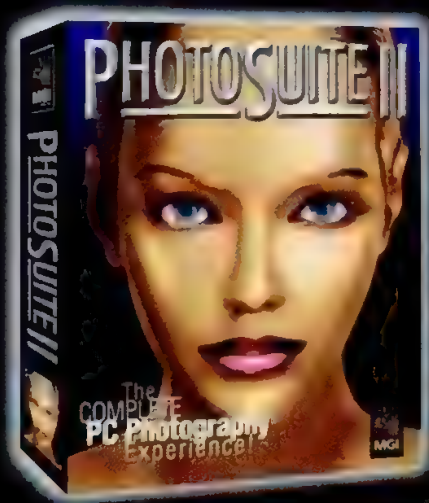
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Making Software Easier Through Usability Testing

Software companies take a rigorous approach to determining how easy their products are to use.

By Neil Randall

Sometimes software seems so mind-bogglingly stupid that it's almost impossible to believe any human being other than the programmer actually worked with the product before its release. In fact, this is almost never the case, except perhaps with some one-person shareware or free-ware offerings. Software from the major publishers routinely undergoes a process called *usability testing*, in which participants put specific features through a variety of different tests. The results of these tests frequently influence the software design itself, thereby making the program easier, more efficient, and more pleasant for the user to work with.

Since this seems like the most reasonable goal in the universe for any software manufacturer, or for that matter anyone who makes anything from can openers to automobiles, you might think that usability testing goes without saying. But except for safety testing, usability testing in the past took place largely in the worst possible arena: the marketplace. In other words, determining whether or not a product was usable was primarily the task of consumers, and only after the product's release. To see this trend, think of the first VCRs: Programming them to do multiday recording tried both our patience and our belief, and most users just didn't bother. Think as well of early computer programs, such as pre-Windows WordPerfect or Lotus 1-2-3, where new releases frequently incorporated suggestions from users. Although bug testing was high on the list of prerelease activities, questions of usability often surfaced only after a package was on the market.

Formal usability testing, on the other hand, is a relatively recent concept, and it became a recognized procedure in the computer industry only about a dozen years ago and a fully integrated procedure only in the past half a dozen or so. Companies have always recognized the need for usability testing of one kind or another, but formal testing takes time and money and can easily delay a product's release. When

usability testing is integrated with product development, the test results must be incorporated into the design itself, and obviously this does nothing to speed things along or to keep the budget crunchers happy. But if the result is a more satisfied customer, then a bit more time and money is a smart investment.

TYPES OF USABILITY TESTING

This column will focus on software testing conducted in a usability-testing laboratory, but other types exist. Surveys and questionnaires can help determine how users perform specific tasks, how they engage interface elements such as icons and menus, how they

unreliable, and in the case of field observation, users face real-world distractions. Controlled tests let designers and developers see how well a program works in and of itself.

A controlled usability test places a single participant (or on rare occasions, two participants) in a particular location where he or she is given a document, or *task list*, outlining a set of tasks to perform in a particular order. For example, a task list might ask a participant to save a document or print a document using landscape orientation. The first requires finding a menu item, an icon, or a hot key, then working with the file/save dialog. The second requires the same, except that the concept of landscape orientation becomes an issue. This test could be designed with visual cues as well, showing the participants an example of a landscape orientation and asking them to print a specific file to resemble it.

A set of linked tasks might ask participants to start a spreadsheet table, enter specific data, perform specific calculations, and print in a specific format. Participants complete each task individually, but by linking them, developers can determine the usability of a procedure that people might actually perform in their jobs. In real life, after all, tasks don't take place in isolation. They're always part of a larger procedure.

Developers, of course, aren't interested primarily in the test itself, but in its results. And that raises the question of exactly what these tests can show them. The quantitative data that testers can gather is *time per task* or *time per task set*, *number of errors*, and *requests for help*. Most important, developers can learn how long it took each participant to conduct the tasks specified in the task list. Someone with a stopwatch can record relatively useful data in this fashion, but as we'll see

below, more precise measurements can be captured with more sophisticated equipment.

But as much as time-per-task data will inevitably help in revising the product design, there's more to these time measurements than is immediately apparent—this is where the importance of observation comes in. Observers record precisely at which point in the task the participant slowed, stopped, got sidetracked, or tried something new. Observers also encourage users to talk aloud when working through the tasks (*talk-aloud protocol*), and they record what users say and where in the task they say it. They also record gestures, ranging from hands thrown up in



FIGURE 1: A usability-testing laboratory is equipped with cameras, microphones, and a one-way mirror (back) to observe participants.

work with help systems and wizards, and how satisfied they feel about these things. Related to these methods are focus groups, widely used in product design of all types, in which a moderator orally questions a group of users. Another type of testing is field observation, where the tester watches people use the software in their work environments.

Primarily, however, usability testing is most effective when it attempts to determine how much time a user needs to complete a task or series of tasks and how difficult the tasks seem. This requires a controlled testing environment, because in the case of questionnaires and focus groups, users' memories are

frustration to hands thrown up in victory, and everything in between.

The idea is to give program teams highly specific user feedback about their design. Instead of postrelease user feedback, which tends to be much less focused ("I couldn't get a graphic into a cell—took me hours!") or completely unfocused ("It just stinks!"), these tests show where user satisfaction is likely to suffer unless the product is altered. If usability testing begins early enough in the product cycle, these potential problems can be isolated in time to change the finished design. In the major software houses, in fact, usability personnel work with development teams from the earliest design stages of the product. Still, even in these cases, a great deal of testing takes place after the product actually works, and by that point features and interface design are pretty well frozen in place. In that case, the test results will affect the next full or interim version of the software.

One popular, inexpensive, and obvious method of at least partially controlled usability testing is for company employees to play the role of test participants and work through a task list. This arrangement can be informal, with the participant doing all the timing and recording, or quite formal, drawing participants from a wide variety of potential users inside the organization. Clearly, this method can be problematic (one employee disparaging another's work brings all sorts of difficulties), but if handled well it can be valuable too.

The most sophisticated method of usability testing occurs in a usability lab. Here, controlled tests of specific tasks can take place, with full observation, recording, and reporting facilities. The obvious disadvantage to this method is cost, in both equipment and personnel, but if the whole point is ensuring user satisfaction, hence current and future sales, the benefits might well exceed this disadvantage. We'll examine a typical usability testing lab next.

In all types of usability testing, one thing must be kept in mind: The software, not the participant, is being tested. Participants must be told in advance that they are indeed participants, not subjects. Because the point of usability testing is to determine where the product's design fails, some tests will almost certainly lead the participant toward failure. It's easy for the participant to feel stupid.

It's just as easy for the product developers to agree. Their brainchild, after all, is under scrutiny and criticism by someone far less technically knowledgeable. Usability management must take this possibility into account, but ultimately this potential stops being a problem only when usability testing is built into the design cycle and respected at all levels.

THE USABILITY TESTING LAB

To research this article, I visited the Usability Testing facilities at the Microsoft campus in Redmond, Washington. Microsoft's Usability Research Group celebrated its tenth anniversary in May. In the past, I have worked with usability labs at IBM in Toronto and Northern Telecom in Ottawa, and I ran a small usability lab at the University of Waterloo in Canada.

What I discovered at Microsoft was that not much had changed in concepts or facilities, except that usability testing is now a recognized area of research in academic disciplines ranging from computer science and

Early prototypes of
Windows 95 fell flat in
usability testing, so the
Start button was
developed as a solution.

human/computer interaction through psychology and technical communication. It has also become an expected feature of the design process, rather than a hoped-for addition. One important perceptual difference is that testing personnel, who are drawn from a variety of academic disciplines, are now called usability engineers, at least at Microsoft. That kind of recognition is obviously important in a high-tech firm. Information about Microsoft's usability facilities is available at www.microsoft.com/usability.

But the basic lab itself has remained much the same over the past decade. The principle is to have two adjacent rooms, the observation room and the testing room, or in Microsoft parlance the *observer side* and the *participant side*. The two rooms are separated by a wall (soundproof, ideally) and a one-way mirror, so that the observers can see the participant but not vice versa.

The testing room (see Figure 1) is typically equipped with one or more computers, a desk and chair (or several), and at least one camera and microphone. The participant sits at the computer while the camera and microphone record all activity. In many cases, the testing room contains two cameras or even three, depending on the subject of the test. One camera captures what's on-screen, unless a scan converter is available to record full-screen motion onto a videotape. A second camera captures the participant's facial expressions and body movements, including mouse and keyboard

movements. If the object of the test is a document, such as a user manual, another camera will focus on it. The testing room also contains speakers through which the participant can hear questions or instructions from the observation room.

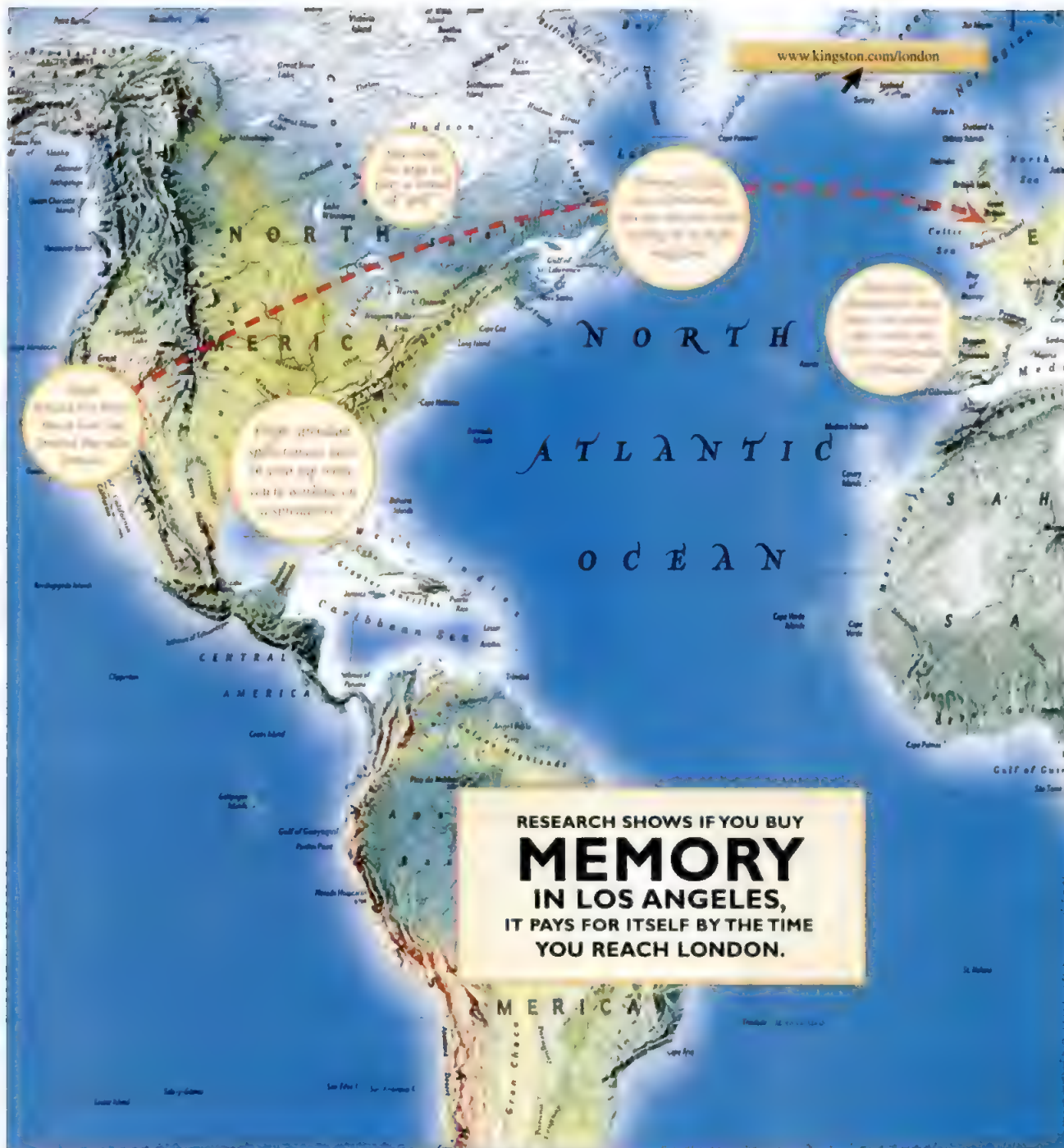
The observation room is even more fully equipped, with at least one computer, a microphone, a VCR with time-stamping capabilities, equipment for controlling cameras, and a video mixer. The microphone lets the observer communicate with the participant, an activity that should happen infrequently. The computer runs *event-logging* software, synchronized to the time stamp on the VCR. The logging software runs throughout the test, and the observer records when the participant starts and finishes a specific procedure and when any significant event occurs.

Significant events include a participant's comments, questions, facial expressions, technical errors, or anything else that reflects the attempt to use the software. Only if the participant needed prompting or if the participant asked a question would the observer use the microphone. Prompting would be necessary, for example, if the participant were so far off-track that he or she couldn't proceed or if frustration were clearly setting in.

In some cases, a second observation room is available, separated from the main observation room by a window. Here, members of the development team can watch the test and discuss the participant's actions as they happen.

Participants are typically drawn from local businesses, sometimes from organizations on the company's client list. Microsoft maintains a database of 25,000 potential participants near its headquarters and uses this database to get the best possible match between product and user. Testing Microsoft Money, for example, requires participants with different levels of experience from those testing Visual C++, so the match is important. There's also a difference between testing basic interface concepts and advanced maintenance options in an operating system.

The number of tests for a specific product depends on how much detail the development team requires. Once the testing is complete, the videotape is edited to show only the highlights of the tests (usability observation isn't a great spectator sport), and the tape and a written report are given to the product manager. At Microsoft, each product or product group has its own usability manager, whose tasks are to determine which of a product's features require testing, to report the results of the testing to the development team, and to work with them on possible alterations.



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PCTech Tutor

REAL-WORLD USABILITY RESULTS

What does all this effort accomplish? Which features of the software you now use work as they do because of usability testing? The answers are: quite a bit, and quite a few. Again, the focus here is on Microsoft products, but from these specifics you can get a sense of how significant usability testing is. At Microsoft, that significance multiplies internally, because development teams are billed for support calls for their products. An unusable product can have a serious effect on the budget.

According to Microsoft, early prototypes of Windows 95 fell flat, with people finding it extremely difficult to make the conceptual switch from Windows 3.x. Participants had a great deal of trouble with seemingly simple tasks such as finding and opening Write (in the Accessories group). Testing revealed that people didn't actually work with the operating system, but rather with applications, and the Start button concept emerged from that realization.

Windows 95 usability testing resulted in enhancements in Windows 98 as well. The installation screen draws from these tests, offering more and better information about what's occurring at each stage. Also changed is the placement of the hardware recognition process, moved to the end of the installation

to make freezes less frightening and easier to recover from. Win98's Maintenance Wizard is also in part the result of this testing. Testing also resulted in the decision to turn off the single-click Web-style interface as the default for Microsoft Internet Explorer 4 and Win98. The final version installs with this option off (unless it's installed atop a Win95 that has it turned on), because participants found the change too jarring.

Office 97 usability testing was and continues to be extensive. Most obviously, the Office Assistant concept resulted in part from this testing, because of the desire of users to have easy and constant access to the help system. Apparently the majority of Office 97 users keep the Assistant running at all times, and usability testing and user feedback has determined that the Assistant gives the right answer about the right topic about 80% of the time. Excel underwent extensive usability testing resulting in significant developments in such features as charting. Mail Merge in Microsoft Word also changed as a result of testing. Also tested extensively was the ability of users to find features; in many cases, the features they wanted were already in the product, but they couldn't easily get to them. This problem continues to receive usability attention.

Other usability-initiated changes to Microsoft products have included the interface to MSN 2.5 and Money 98. Microsoft changed MSN 2.0's large animated graphic at the top because it confused people, and the company added mouse-over information about specific shows. Money 98 was changed to allow users to switch easily between accounts and to turn off the auto-fill suggestion.

THE GOOD AND THE BAD OF USABILITY TESTING

Nobody's going to argue that usability doesn't matter, especially in a market where steep learning curves are frowned on. The easier a product is to use, the more likely a customer will stick by it and upgrade to new versions as they become available. But one problem with relying on usability testing is that new features might be eliminated because their effectiveness wasn't immediately apparent. In other words, there's a fine line between listening to users and pandering to them, and usability specialists must be aware of this. Still, even with this danger, usability testing makes things easier to use, and that's a win/win proposition. **PC**

Neil Randall is the author of The Soul of the Internet (ITCP) and Special Edition Using Microsoft FrontPage98 (Que).

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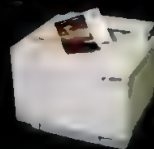
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Inside JavaBeans

A simple demonstration Bean gets you started programming Java's version of reusable components.

By John Muchow

Don't reinvent the wheel! is a maxim that most developers would do well to live by. But in the real world, this guideline often slips by the wayside. Now there's a welcome entrant among developer tools that can save you from treading over old ground unnecessarily.

The JavaBeans API is the model for creating reusable software components with Java. Although the API is very extensive (and unfortunately a moving target), once you familiarize yourself with the basics, creating a Bean is really quite simple. Before moving on, download the Bean Development Kit (BDK) available from Sun (java.sun.com/beans). Included in the BDK is a program known as BeanBox. This tool is designed not as a development environment but as a repository in which you can test your Beans for basic functionality. Figure 1 shows a screenshot of the BeanBox.

Hereafter we will use the term *Bean builder* to refer to any software tool that includes support for loading, writing, and customizing Beans.

So just what is it that makes a Bean a Bean? In its simplest form, a Bean is nothing more than a Java class, or set of classes. What makes a Bean unique is that it can expose its properties, events, and methods to a Bean builder. From the Bean builder's point of view this is known as *introspection*. A Bean can also provide customization features that allow for modifying its appearance and functionality. Finally, through a process known as *persistence*, a Bean can save and restore its state.

PROPERTIES, EVENTS, AND METHODS

Properties represent the attributes of a Bean. Some properties represent visual attributes, while others do not. For example, the color of a button is obviously visual, whereas a Boolean variable indicating whether a button is enabled is not. The properties dialog shows Bean properties and lets you configure them. The property sheet of the BeanBox is shown on the right-hand side of Figure 1.

Communication between Beans is based on event handlers, which listen for events triggered by other Beans. When an object (the target) is interested in notification that an event has occurred on a remote object

(the source), it registers itself as a listener. Let's set the stage for a simple example. We have two Beans, a button Bean and a database Bean. When the button is pressed, the database Bean executes a SQL statement to query a database. To facilitate this intercommunication, the database Bean registers a "listener event" with the button, requesting notification when there is a click of the mouse. The database Bean specifies which method or set of methods to call when the event occurs. When the button is clicked, a message is sent notifying the database Bean that the listened-for event has taken place. The database Bean is then responsible for its part of the transaction, namely, executing a SQL statement.

It is also worth mentioning that Beans can accept registrations from multiple components. That is, a Bean can have many listeners. An event inside the source Bean can trigger a reaction in any number of listening Beans.

There is nothing special about the methods of a Bean. They are standard Java methods that provide whatever functionality you see

```
public void  
set<PropertyName>(<PropertyType> x)
```

And if you want to create a button in which text is exposed as a property, you can write the following:

```
public String getText()  
public void setText(String text)
```

Design pattern analysis is the default means of introspection. A Bean is scrutinized for simple patterns to determine what to export. The advantage of using design patterns is that no information outside of the Bean class itself is required. Also, design patterns promote code readability by providing a coding standard, albeit a somewhat limited one.

If design patterns cramp your style, or if you require more control over which methods are exported, you can implement a *BeanInfo* class. In addition to the enhanced control a *BeanInfo* class affords, you can add information not available through design patterns. You will see an example of a *BeanInfo* class when we write our sample Bean.

CUSTOMIZATION

As mentioned previously, Bean attributes can be configured using a properties dialog. This dialog is created on the fly in the Bean builder based on the information gathered through introspection.

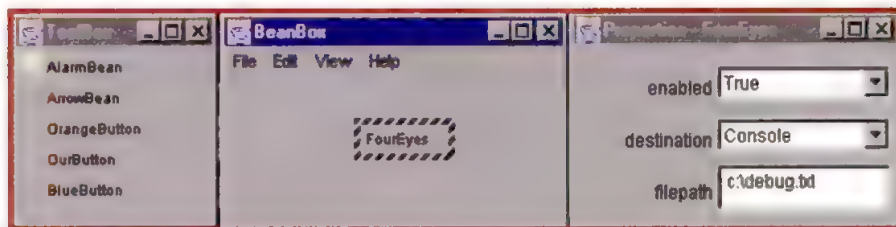


FIGURE 1: The Bean Development Kit (BDK) from Sun includes this program, known as the BeanBox, a repository in which you can test your Beans for basic functionality.

fit. What is noteworthy is that any methods declared *public* are exported and accessible from other components.

INTROSPECTION

When creating a Java class, if you follow the design patterns outlined in the Beans specification, a Bean builder can look inside and determine the properties, events, and methods the Bean supports. This is known as *introspection*.

For example, here is the pattern for defining the methods that permit getting and setting the value of a property:

```
public <PropertyType>  
get<PropertyName>()
```

In Figure 1, the drop-down list next to the Boolean variable *enabled* and the text box next to the String variable *filepath* are known as *property editors*. Internal property editors support the most common Java data types. For other data types within your Bean, you can write your own editor. You'll see a simple editor as part of our sample Bean.

As Beans take on more complexity, the standard property sheet becomes inadequate. When this is the case, you can write a customizer class that will replace the property sheet entirely. A good example is when you would like to present a wizardlike interface. Taking this example a step further, if you were

```
public class FourEyes implements Serializable
{
    boolean enabled = true;           // Write messages?
    int destination = CONSOLE;        // Where to write them
    String filepath = "c:\\debug.txt"; // Location for file messages

    static final int CONSOLE = 0;     // Constants for 'destination'
    static final int FILE = 1;
    static final int BOTH = 2;

    public FourEyes()
    {
    }

    public void setFilepath(String path)
    {
        filepath = path;
    }
    public String getFilepath()
    {
        return filepath;
    }
}
```



FIGURE 2: Here's an abbreviated listing of the first of *FourEyes*'s three classes. Notice this class implements *Serializable*, and that it's a no-argument constructor method.

creating a database-access Bean, one aspect of your customizer might be a GUI interface for visually linking fields between tables.

PERSISTENCE

Software tools should learn how you work. When you restart a program, you expect it to remember where you were last. You expect an application created with a Bean to show the same courtesy. This logic also applies to a Bean builder. For example, if you set a Boolean variable to false in the property sheet, you would expect the value to be the same when you restart the application. In Java-speak, this is called *serializing*.

All that is required to serialize an object is that the Bean implement the *Serializable* interface somewhere in its hierarchy. Here is a sample class declaration:

```
public class SmallBean implements
Serializable
```

All variables inside an instance of *SmallBean* will automatically be serialized. Well, almost all variables (there's one in every crowd)—variables declared as *transient* will be ignored.

If you need more control, or prefer to write the output in a proprietary file format, you can use the *Externalization* interface. The advantage to this is that *you* decide what to serialize. On the downside, you're responsible for writing all the code. The choice is yours.

"HEY, FOUR-EYES"

To put all this to the test, let's step through a simple Bean—nothing too earth-shattering, yet useful nonetheless.

Although most development tools are packaged with a debugger, we often opt for a much less elegant solution—a few carefully placed `println()` statements. *FourEyes* is a Bean that simplifies using such code. All you

need to do is drop the Bean into your project, choose the output location for your messages (console, file, or both), and insert calls to the `writeMsg()` method. When you are ready to distribute your application, toggle the Bean property `enabled` to false, and all calls to `writeMsg()` become inactive.

There are three classes that make up *FourEyes*. Figure 2 shows an abbreviated listing of the first class. Something should look familiar right from the start—this is the class that implements *Serializable*. Next, notice the no-argument constructor method. This is a requirement for every Bean. Also shown are the two `set/get` methods for specifying the output path when writing messages to a file. Notice both methods follow the design patterns profiled earlier.

For brevity, `writeMsg()` is not shown here. Rest assured, you're still getting your money's worth; `writeMsg()` uses standard Java I/O and is included as part of the source available for download from *PC Magazine's* Web site.

We'll store the destination for messages as an integer (0 = Console; 1 = File; 2 = Both). Without a custom editor, the property sheet displays a field that accepts any integer value—not very robust to say the least. Using a custom editor, we will tailor the property sheet to display a drop-down list containing the following strings: *Console*, *File*, and *Both*. This leads to our second class, *FourEyesEditor*, shown in Figure 3.

The two methods inside *FourEyesEditor* work together as follows: `getTags()` returns an array of *String* objects—the entries dis-

```
public class FourEyesEditor extends java.beans.PropertyEditorSupport
{
    static final String outputConsole = "Console";
    static final String outputFile = "File";
    static final String outputBoth = "Both";

    public String[] getTags()
    {
        return new String[] {outputConsole, outputFile, outputBoth };
    }

    public void setAsText(String str)
    {
        if (str.equals(outputConsole))
            setValue(new Integer(FourEyes.CONSOLE));
        else if (str.equals(outputFile))
            setValue(new Integer(FourEyes.FILE));
        else if (str.equals(outputBoth))
            setValue(new Integer(FourEyes.BOTH));
        else
            throw new IllegalArgumentException (str);
    }
}
```



FIGURE 3: The *FourEyesEditor* class returns the entries displayed inside the property sheet as *string* objects. When an entry is selected, it sets the integer value of the newly selected entry.

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PCTech Power Programming

```
public class FourEyesBeanInfo extends SimpleBeanInfo
{
    public PropertyDescriptor[] getPropertyDescriptors()
    {
        try
        {
            PropertyDescriptor
                enabled = new PropertyDescriptor("enabled",
FourEyes.class),
                filepath = new PropertyDescriptor("filepath",
FourEyes.class),
                destination = new
PropertyDescriptor("destination", FourEyes.class);

            // Define help messages for IDEs (these are NOT
supported in the BeanBox)
            enabled.setShortDescription("Show debug
messages?");
            filepath.setShortDescription("Filepath to
logfile.");
            destination.setShortDescription("Destination for
messages.");

            PropertyDescriptor[] props = {enabled, filepath,
```

```
destination};

            // Set the property editor for the 'destination'
variable
            props[2].setPropertyEditorClass(FourEyesEditor.class);

            return props;
        }
        catch (IntrospectionException e)
        {
            return super.getPropertyDescriptors();
        }
    }

    public Image getIcon(int kind)
    {
        if (kind == ICON_COLOR_16x16)
            return
loadImage("FourEyes.gif");
        else
            return null;
    }
}
```



FIGURE 4: The *FourEyesBeanInfo* class.

played inside the property sheet. When an entry is selected, `setAsText()` uses a simple string comparison to determine what integer value corresponds to the selected entry. `setValue()` completes the operation by setting the integer value of the newly selected entry.

Next we must tie together our custom property editor with the associated property in the property sheet. You can look at this another way—when you click on the drop-down list (in the property sheet) to select a destination, the Bean builder needs to know which

method creates an array of all the properties available inside our Bean. We have also added a call to `setShortDescription()`. This method lets a Bean builder display a short help message when the mouse cursor briefly pauses over the property (the BeanBox tool included in the BDK does not support this feature). Through the call to `setPropertyEditorClass()`, we inform the Bean builder which property editor to call when the file destination property is selected on the property sheet.

As the final touch, through a call to `getIcon()`, we associate an image with our Bean.

PACKAGING YOUR BEANS

Once you have successfully compiled the Java files, there is one final step before you can use or distribute the Bean. All Beans must be packaged into a JAR (Java Archive) file. To create the JAR file for *FourEyes*, execute the following from the command line:

```
jar cfm FourEyes.jar
manifest.txt FourEyes/*.class
FourEyes/FourEyes.gif
```

`cfm` represents three separate command line parameters—(*c*)reate a new archive; (*f*)ile-name of the archive; and include (*m*)anifest information from the specified file. A manifest file describes the contents of the JAR—more

specifically, which files in the JAR are Beans. The *FourEyes* manifest.txt file is as follows:

```
Name: FourEyes/FourEyes.class
Java-Bean: True
```

At this point you are ready to add the Bean to your Bean builder.

Figure 5 shows the Bean inside Borland's JBuilder. First, notice the image on the Component Palette. Second, because this is a non-visual Bean, there is no visual representation on the frame (as there is for `buttonControl1`). Finally, notice the help message displayed in the property sheet (the mouse cursor does not appear in this screenshot). If you've followed closely, you'll recall this message is read from the *FourEyesBeanInfo* class.

TO SUM IT ALL UP

You are free to use and modify this code. But if you make changes you would like to share with others, please send a copy my way. I will post the features that add the most bang for the buck while keeping *FourEyes* small and simple.

One primary objective of the JavaBeans API was to keep the component architecture simple. Although not quite a walk in the park, creating a Bean is no major undertaking if you understand the basics. **PC**

John Muchow is a freelance writer and consultant. You can contact him by sending e-mail to johnm@nutritionforlife.net.

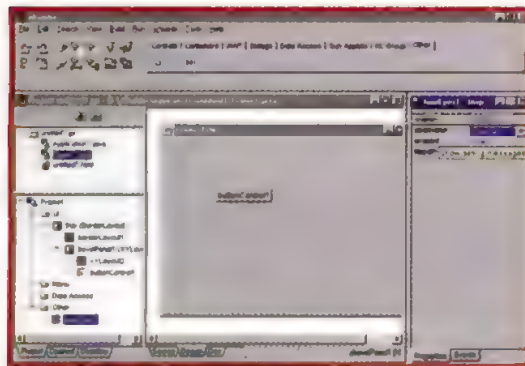


FIGURE 5: Our *FourEyes* Bean inside Borland's JBuilder.

class to call to edit that property. What we need is a *BeanInfo* class.

To make it possible for a Bean builder to locate your *BeanInfo* class, use the name of your Bean, with the string *BeanInfo* appended—in our case, *FourEyesBeanInfo*. Take a look at Figure 4. The `getPropertyDescriptors()`

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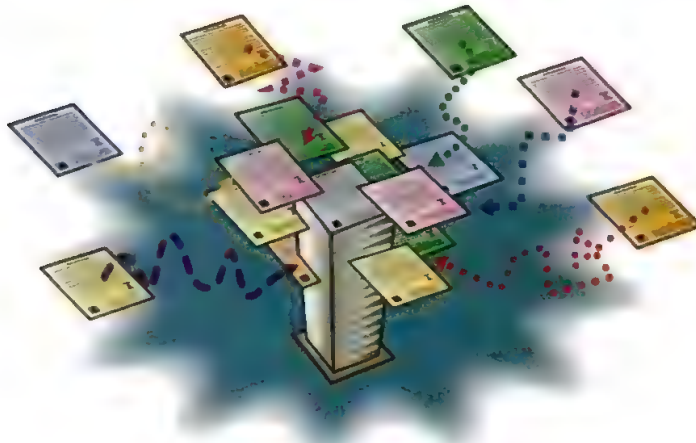
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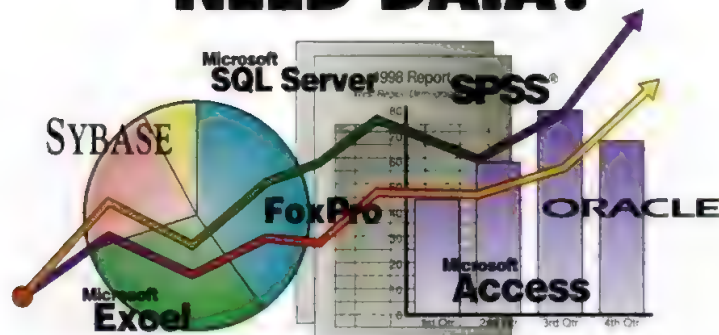
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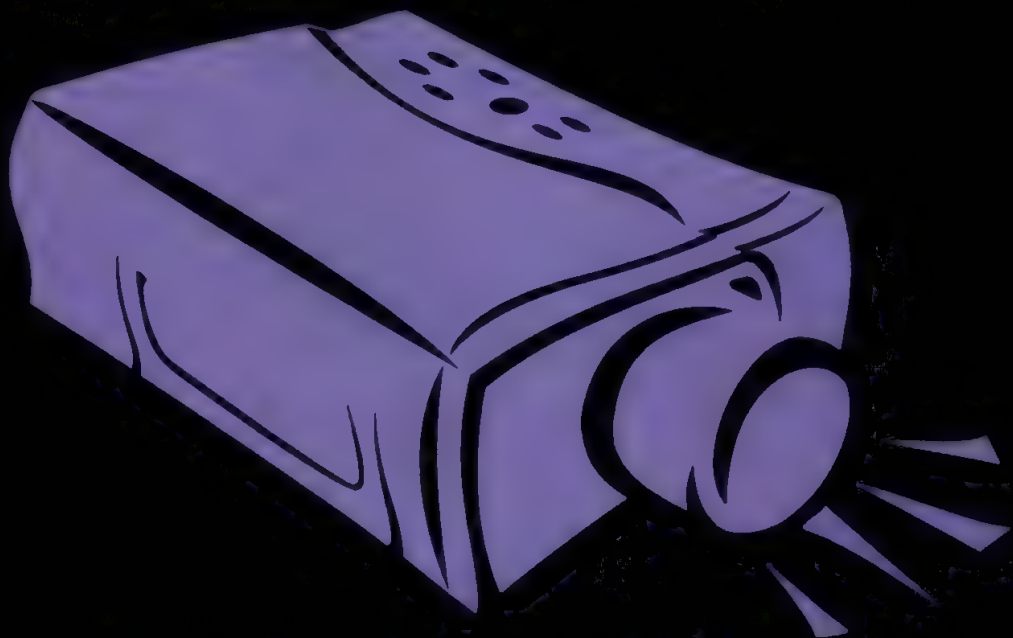
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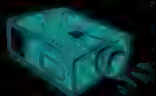


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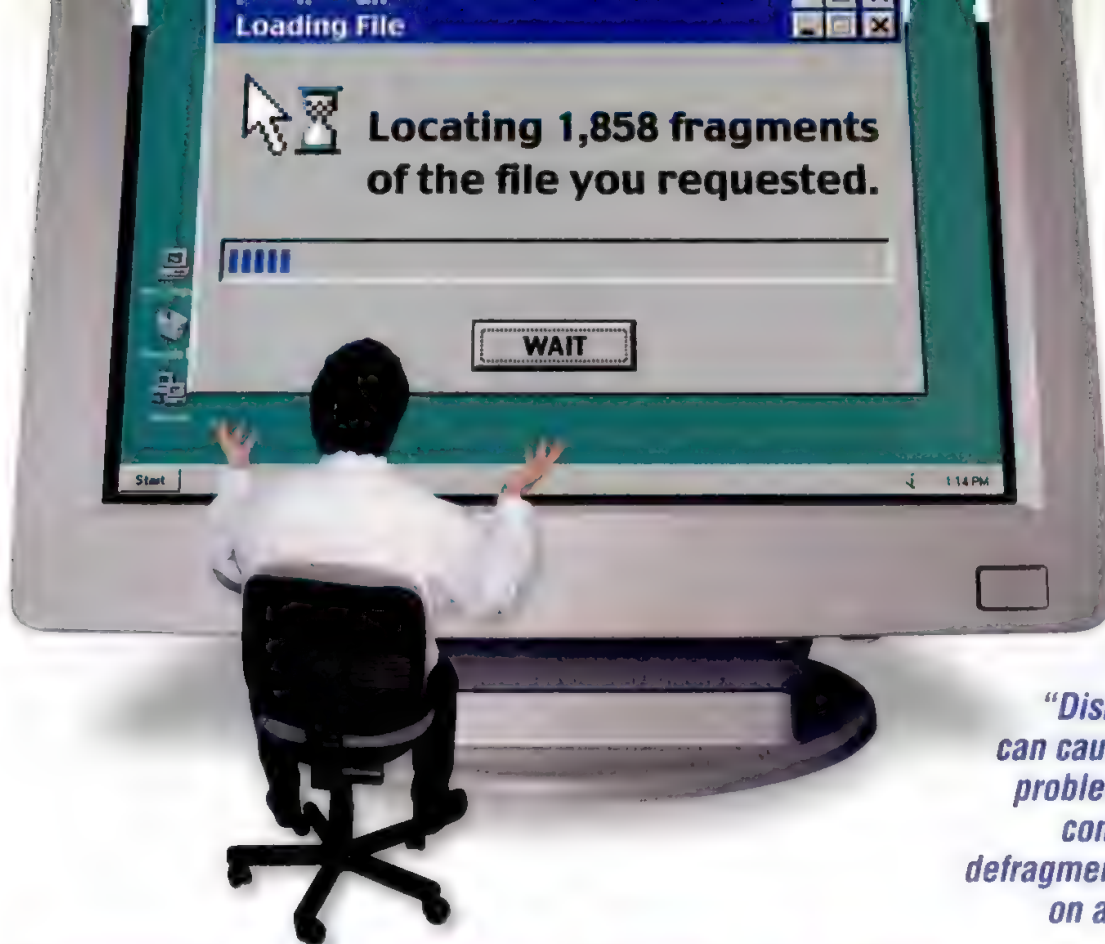
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Nautical Flags: A Windows Screen Saver

Fill your idle Windows 95 or 98 screen with these colorful flags and pennants.

By Mark A. Cihlar

Screen savers are no longer necessary to prolong the life of your monitor, but they add a personal touch, and they can be used to password-protect your computer when you're away from your desk. If you're a maritime enthusiast, you'll enjoy this issue's free utility, Nautical Flags, a screen saver for 32-bit Windows. When active, it displays a random and changing assortment of flag images. The program offers all the features of the screen savers distributed with Windows, including password protection and a preview display in the miniature monitor in the Display Properties dialog.

Nautical Flags displays the International Code of Signals flags and pennants used aboard ships all over the world to spell out messages. There are 40 flags and pennants in all—26 flags for the letters of the alphabet, 10 pennants for the numbers 0 through 9, 3 pennants used to substitute for or repeat the other flags, and 1 flag for answering. (An Easter egg reveals the complete set of flags and pennants, along with program credits.) Ships can use the substitute or repeat pennants to avoid carrying more than one set of flags. Some of the alphabetic flags also have special meanings. For example, the "A" or Alpha Flag, when used alone means, "I have a diver down. Keep well clear at low speed." To learn more about International Code Signal Flags and Pennants, you can look up several Internet sites that contain more information, for example, www.sacdelta.com/signal-meaning.htm.

You can obtain Nautical Flags by downloading it from PC Magazine Online or by mail. Refer to the sidebar "How to Get the Files" for details. The source code for Nautical Flags, which was written in Visual Basic 5.0, is also provided for those interested in seeing how the program works.

USING NAUTICAL FLAGS

To install Nautical Flags under Windows 95 or Windows 98, copy the file Nautical



THE NAUTICAL FLAGS screen saver is shown here with the display dimensions set to 10 by 10.

Flags.scr to the System folder (typically this is C:\Windows\System). If you are running Windows NT, copy it to the System32 folder (typically this is C:\WinNT\System32).

In addition, you must install the Visual Basic 5.0 runtime file Msvbvm50.dll in this same folder. Nautical Flags will not run if this file is missing, but unfortunately there is no

way for it to display an error message explaining the problem. You can obtain this file, if you need it, from the same place where you obtain the program.

To configure and preview Nautical Flags, open the *Display Properties* dialog by right-clicking on the desktop and selecting *Properties*. Select the *Screen Saver* page, choose Nautical Flags as your screen saver, then click the *Settings* button to configure its options (see Figure 1). The *Display Size* setting lets you select the number of flags to be displayed. The fewer the flags, the larger the display of each flag. The size of the flag for the selected option is displayed on the right. The *Display Speed* setting lets you control how long each flag is shown on the screen before the next flag is displayed. With the fast setting, flags are displayed twice as fast as with the slow setting.

To view Nautical Flags operating in full-screen mode, click the *Preview* button. While Nautical Flags is running in full-screen mode, you can access the Easter egg screen by pressing the Z key immediately followed by the D key (for Ziff-Davis, publisher of *PC Magazine*). The Easter egg displays the complete set of flags and pennants, along with program credits (see Figure 2).

INSIDE NAUTICAL FLAGS

Nautical Flags was written with Visual Basic 5.0. The code is organized in one Basic module and three form objects. The Basic module, *ScrnSavr.bas*, contains the routines common to all screen savers and is designed to be reused. The form object *Display.frm* contains the code for creating the screen saver images, including the hidden credits screen. The form object *Config.frm* contains the code for configuring the options in Nautical Flags. The last form object, *About.frm*, displays the copyright message that is displayed when the user clicks the *About* button in the *Options* dialog.

For Programmers Only Nautical Flags is a 32-bit Windows screen saver written in Visual Basic 5.0. The full source code for Nautical Flags is available from PC Magazine Online (www.pcmag.com) and demonstrates several interesting programming techniques, including:

- How Windows communicates with screen savers;
- How to implement the mini-monitor preview;
- How to manage the screen saver password.

Support Help for PC Magazine's free utilities can be obtained in our online discussion areas, both on the World Wide Web (www.pcmag.com/discuss.htm) and on ZDNet in the Utilities section of ZDNet's Tips Forum (GO ZNT:TIPS). The authors of current utilities generally visit this forum daily. You may find an answer to your question simply by reading the messages posted in the forum. If the author is not available and the forum sysops can't answer your question, the Utilities column editor, who also checks this forum each day, will contact the author for you.

The biggest challenge in writing Nautical Flags was getting the many elements of a Windows-standard screen saver to work using Visual Basic 5.0 as the programming language. VB5 doesn't include detailed documentation on how screen savers function, so I studied the Windows API and did a lot of experimentation. I will pass on what I learned in the pages that follow.

COMMAND LINE ARGUMENTS

Windows sends instructions to screen savers by means of command line arguments:

Argument	Meaning
none	Display the configuration dialog.
/a	Display the Change Password dialog.
/c	Display the configuration dialog.
/p #	Run in the preview window (# is the handle of the preview window).
/s	Run full screen.

All other command line arguments are invalid and should be ignored by the screen saver. I specified as the Startup Object a subroutine that parses and processes the command line arguments.

There are two inconsistencies in the command line arguments specified by Windows. First, note that the /c argument has the same meaning as no argument. This is because there are two ways to display the configura-

without a command line argument, the *Configuration* dialog should appear. So Windows does something completely unexpected. When it detects that the file is a screen saver, it automatically adds /s to the command line. This instructs the screen saver to run in full-screen mode.

FULL-SCREEN OPERATION

In order for Nautical Flags to operate properly as a screen saver, both the form-load and form-paint event handlers have to terminate completely. When I tried to include (or call) the flag display code in these event handlers, the program exhibited display problems and sometimes wouldn't even execute. To work around this, Nautical Flags uses a timer and the timer event handler to display the flags. The timer is enabled by the form-load event. Every time the timer triggers, Nautical Flags selects a flag at random and displays it at a random location on the screen. The timer interval is calculated by dividing a constant that corresponds to the user-selected display speed by the number of flags that need to be displayed.

Windows runs its own timer whenever mouse and keyboard activity cease. The user sets the interval in the *Wait Time* field of the *Display Properties* dialog. When the timer triggers, Windows executes the command `Nautical Flags /s`, instructing Nautical Flags to run in full-screen mode. Nautical Flags must first check to see if another copy of itself is already running. If you are familiar with Visual Basic, you may think you can do this by calling `App.PreviousInstance`. Unfortunately, it is not that easy.

When the user selects Nautical Flags as the screen saver, it runs in preview mode in the miniature monitor in the *Display Properties* dialog—a child window. If the user clicks on the *Preview* button, Windows will attempt

to start a full-screen version of Nautical Flags while trying to stop the version of Nautical Flags that is running in preview mode. If I had used `App.PreviousInstance` as a check, Nautical Flags would not run in full-screen mode when the user clicked *Preview*; the instance running in the preview window would prevent it.

The Windows API provides a solution. The function `FindWindow` can search all top-level windows for a specified window class and name, and it returns a handle to the win-

dow if a match is found. You can search for just a window title, but this can be unreliable because any window may have a particular title. The window class for VB5 forms is `ThunderRTSForm`. ("Thunder" was the pre-release code name for Visual Basic.) The display form caption—the window name in full-screen mode—is "Screen saver". This lets Nautical Flags identify instances running in full-screen mode, while ignoring those in preview mode.

When Nautical Flags is running, the *Ctrl-Alt-Del* and *Alt-Tab* key combinations must be disabled to ensure proper password protection. Nautical Flags accomplishes this with a call to the Windows API function `SystemParametersInfo` using `SPI_SCREENSAVERRUNNING` as the first parameter. The second parameter `uiParam` is set to `True` or `False` to tell the system whether the screen saver is running. When it is, Windows prevents these key combinations from performing their special functions. The form-unload event for Nautical Flags restores the special meaning of these key combinations with another call to `SystemParametersInfo`, this time with `uiParam` set to `False`.

Nautical Flags also must hide the mouse cursor while running. A simple call to the Windows API function `ShowCursor` with `bShow` set to `False` hides the mouse cursor during screen saver operation. The Nautical Flags form-unload event restores the mouse cursor by calling this function with `bShow` set to `True`. The password verification routine makes the mouse cursor temporarily visible while the password entry dialog is displayed, and hides the mouse cursor when password entry is finished.

PREVIEW MODE

Getting Nautical Flags to work in preview mode was one of the more difficult features to implement. In preview mode, Nautical Flags is displayed in the miniature monitor shown on the *Display Properties* dialog. Don't confuse preview mode with selecting the *Preview* button on the *Display Properties* dialog. The *Preview* button causes Nautical Flags to operate in full-screen mode, and is not the same as preview mode.

When the user selects Nautical Flags from the drop-down list of screen savers, Windows executes the command `Nautical Flags /p #`. The /p argument instructs Nautical Flags to run in preview mode. The # argument is the handle for the preview window—the miniature monitor in which the preview is displayed.

The first step in preparation for preview mode is to load the display form, but without

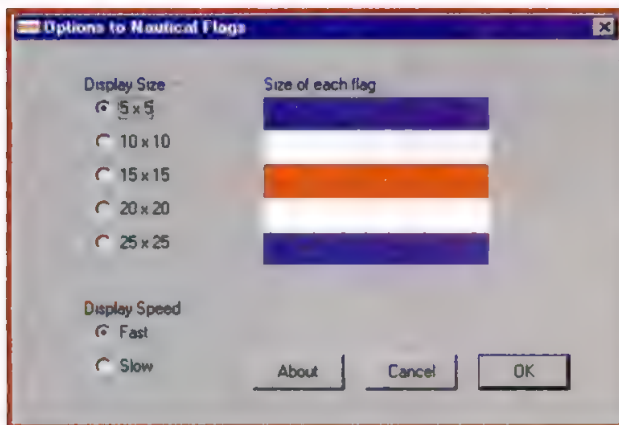
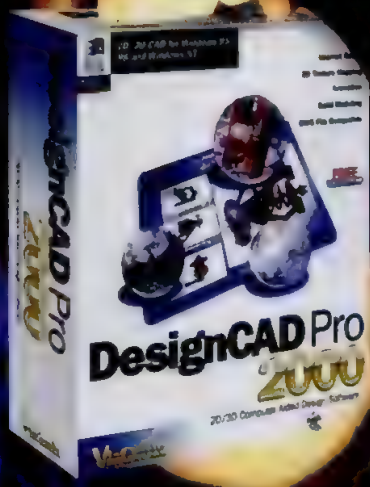


FIGURE 1: Nautical Flags' configuration dialog lets you set the number of flags to display and the display speed.

tion dialog. When the user clicks the *Settings* button on the *Display Properties* dialog, Windows executes the command `Nautical Flags /c`. If the user right-clicks on Nautical Flags in Explorer and selects *Configure* from the menu, Windows executes the command `Nautical Flags` with no argument.

The second oddity arises when the user double-clicks `Nautical Flags` in an Explorer window. The desired behavior is for Nautical Flags to execute in full-screen mode, but

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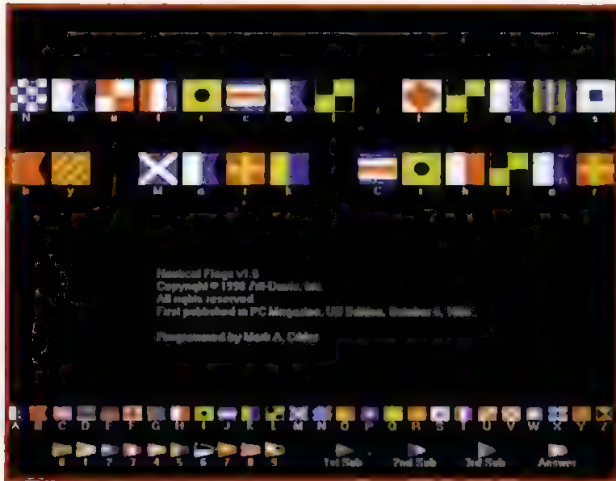


FIGURE 2: The hidden credits screen shows the complete set of flags and pennants along with their single-flag meanings.

showing it. Next, Nautical Flags parses the command line argument to get the handle to the preview window. The handle is extracted with the Visual Basic command `Val(Mid$(Trim(CmdLine), 4))`. The program then calls the Windows API function `GetWindowLong` to retrieve the window style for the display form. At this point, Nautical Flags has all the information necessary for pre-

view mode operation.

For preview mode, Nautical Flags must change the window style for the display form into a child window. It gets the current window style value by calling `GetWindowLong`, then ORs that value with the constant `WS_CHILD`, and calls `SetWindowLong` to set the display form's window style to this new value. Finally, Nautical Flags calls the API function `SetParent` to make the preview window the parent for the display form, and the screen saver executes within the miniature monitor screen.

Windows shuts down the preview mode display if the user selects any of the other screen saver functions in the *Display Properties* dialog, and restarts preview mode when the *Display Properties* dialog becomes active again. For this reason, Nautical Flags ignores any mouse or keyboard activity and suspends password protection when operating in the preview mode.

PASSWORD PROTECTION

Windows NT manages password protection for screen savers, so this section is not applicable for Windows NT. In Windows 95 and Windows 98, the screen saver itself is responsible for managing all of the tasks associated with password protection, though the password itself is stored at the system level and shared by all screen savers. Nautical Flags manages the password entry dialog, verifies that the password entered is correct, and lets users change the Windows screen saver password.

When Nautical Flags is running in full-screen mode, any mouse or keyboard activity other than the special Easter egg keystrokes causes it to check whether it's okay to stop. First, the program sets the current mode flag to indicate that it's verifying the password. This prevents further mouse or keyboard activity from repeatedly triggering password verification. Next, the program determines whether password protection is enabled. This information, along with the encrypted password itself, is stored in the Windows Registry. Nautical Flags calls the API function `Password Enabled` to open the correct registry key, read the setting, and close the key. This function returns `True` if screen saver password protec-



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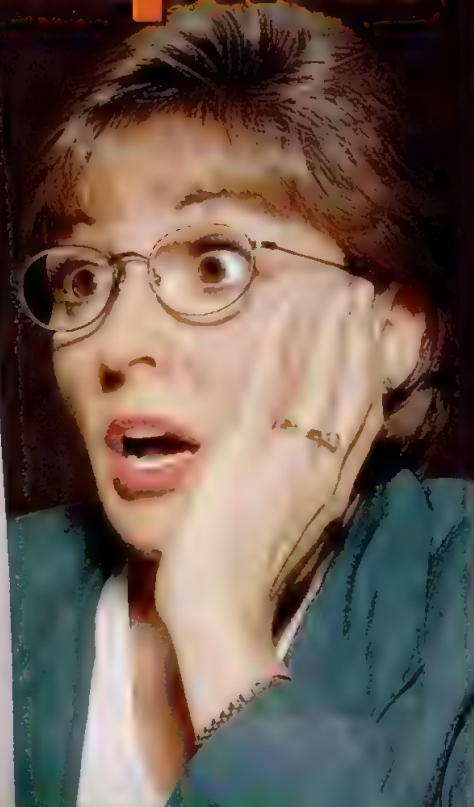
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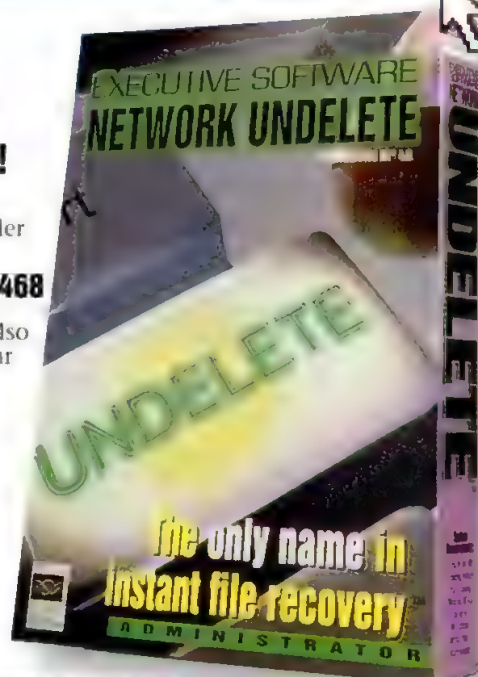
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tion is enabled. Surprisingly, more code is required to read this one piece of information than to implement any of the other password protection features!

If password protection is not enabled, Nautical Flags completes a few shut down activities and ends. If it is enabled, Nautical Flags prompts the user for the password, encrypts what the user enters, and compares the encrypted password to the one stored in the Windows Registry. If the two match, Nautical Flags executes its shut down routine; otherwise it displays an error message. The user can then reenter the password, or click the *Cancel* button to return to screen saver operation.

This requires less code than you might think because the Windows API function `VerifyScreenSavePwd`, exported from the file `Password.cpl`, takes care of everything. It displays the password entry dialog, processes user input, encrypts the password, and verifies that the passwords match. `VerifyScreenSavePwd` is called with the window handle that becomes the parent of the password-entry dialog. This allows the function to center the password-entry dialog on the display. `VerifyScreenSavePwd` returns `True` if the passwords match, or `False` if they did not match or if the *Cancel* button was selected.

If the user clicks the *Change* button to change the password, Windows executes Nautical Flags with the `/a` command line argument. Nautical Flags then prompts the user to enter a new password twice, verifies that both entries are identical, encrypts the new password, and stores it in the Windows Registry. This also sounds as though it would require a lot of code, but the Windows API function `PWDChangePassword`, exported from the file `Mpr.dll`, does all the work. The subroutine `PWDChangePassword` takes four arguments. The first is the name of the password provider for which you want to change the password. Windows supports a number of password providers; the name of the screen saver password provider is `SCRSAVE`. The next argument is a window handle that will

become the owner of the change-password dialog box. This is determined by a call to the Windows API function `GetForegroundWindow`. The last two arguments are flag values that should be set to zero. Note that the definition in MSDN (Microsoft Developer Network) differs from this, and is apparently incorrect.

CONFIGURATION DIALOG

When the user clicks the *Settings* button in the *Display Properties* dialog, Windows executes Nautical Flags with the `/c` command line argument to bring up the configuration dialog. Selecting *Configure* from the context menu that appears when you right-click on Nautical Flags.scr in Explorer will also bring up this dialog.

Nautical Flags lets the user set the number of flags in the display and the speed at which the flags change by clicking on radio buttons. The click event handler sets the number of flags, and then calls a routine to display a sample flag at the size it will appear during full-screen execution.

When the user selects the *OK* button, Nautical Flags saves the settings in the Windows Registry and unloads the configuration dialog. If the user clicks the *Cancel* button or hits the *Esc* key, Nautical Flags unloads the configuration dialog without altering the settings stored in the Windows Registry.

DRAWING THE FLAGS

In the first version of Nautical Flags, I used the Visual Basic graphic commands `Line` and `Circle` to draw each of the individual flags. This worked fine on computers running Windows 95, but under Windows NT it executed so slowly that you literally could watch each line on the flags being drawn!

To solve this problem, I rewrote the flag display subroutine to use Windows API graphics functions in place of the Visual Basic graphic commands. I was able to draw all the flags with just three primitives: `Ellipse` for circles, `Polygon` for triangles, trapezoids, and diagonal stripes, and `Rectangle` for rectangular areas.

Nautical Flags now runs equally fast on Windows 95, Windows 98, and Windows NT.

EASTER EGG

Nautical Flags contains a hidden credits screen, also known as an Easter egg. Users access Easter eggs by entering a unique sequence of keyboard or mouse-click events. In Nautical Flags, the required sequence of events is pressing the Z key immediately followed by the D key.

To implement the Easter egg, I modified the event handler for trapping keyboard activity to watch for the chosen Z-key-followed-by-D-key sequence. I used a static variable called `LastKeyWasZ` as a flag to track whether the last key pressed was the Z key. When the Z key is pressed for the first time, the keyboard event handler sets the flag to `True` and ignores what would otherwise be considered a valid event for checking whether it's okay to stop. If the next key pressed is the D key, then Nautical Flags calls the subroutine that displays the Easter egg. If the user presses any other key (including the Z key for a second time), Nautical Flags will process the keyboard activity in the normal way and determine whether it's okay to stop.

When the Easter egg is first activated, Nautical Flags sets the current-mode flag to indicate that it's displaying the hidden credits. The display will continue until the user initiates mouse or keyboard activity. The event handlers for mouse and keyboard activity will then set the current-mode flag back to screen-saver mode, and screen-saver operation will resume.

Nautical Flags decorates your desktop with all 40 of the international signal flags and pennants. It also demonstrates all the techniques needed to write a complete and fully functional Win32 screen saver using VB5. **PC**

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Scanners

The Ins and Outs of Purchasing Your Own Scanner

Scanners are truly a "fun" peripheral. While they have serious business uses, they also allow you to be wonderfully creative with your computer.

Scanners were once considered to be expensive and exotic peripherals, intended only for graphics professionals. Recently, as a result of falling prices and the advent of more powerful computers, scanners have entered the mainstream and become an increasingly popular option.

Whether you are a serious electronic publisher or a casual newbie, purchasing a scanner can be a daunting experience. There is a wide variation in price and performance and a myriad of available configurations, each suited to a particular job. In addition, there are a number of interface options and confusing specifications to weigh.

However, no matter what type of scanner you buy, all have a similar purpose. Scanners acquire images from a variety of media and allow you to store them on your computer. Using image manipulation software, you can then transform and enhance your graphic files for display on Web pages, in printed materials, or any place that a picture helps convey a message.

Determine Your Needs

Your first consideration before making a purchase is to determine exactly what you will use the scanner for. Scanning images to be used in professionally printed materials — like magazines and brochures — requires the highest degree of detail and color accuracy, while scans intended for Web pages or presentations need a much lower level of resolution. Generally speaking, getting the highest quality image requires more sensitive —



and thus more expensive — equipment.

Consider carefully the volume and type of materials that you will be scanning. If you are scanning slides or photographs, there are specific scanners dedicated to this type of media. Books and irregularly shaped objects can't be handled by sheet scanners. And if you will be scanning a large volume of pages, it will be important for you to note scanning speed.

Professionals Use Drums

Drum scanners are the choice of professionals demanding the highest quality images possible. Originals are secured inside a specialized tube with clamps while the optics typically move within the drum as it is rapidly spun. These high-end devices can closely resemble barbershop poles and are usually the most expensive to purchase.

Flatbeds Most Popular

The most common type of scanners on the market are flatbeds. These closely

resemble copy machines with a glass plate where the original is placed and a fold down cover to both hold the material flat and block out ambient light.

Flatbed scanners are extremely versatile. They can handle a wide variety of materials and produce high-quality scans. The scanning area is typically of letter or legal size. While this may be sufficient for most users, tabloid and larger scanners can be found, but expect to pay a premium for the added capability.

Some flatbed scanners are even able to scan transparencies

such as color film in addition to standard reflective materials. Since the light source has to be placed differently for film, scanners with this capability are equipped with specialized transparency adapters.

Also available as an option for many flatbeds are automatic document feeders. These are an ideal accessory for those who need to scan large numbers of documents. Coupled with optical character recognition (OCR) software — software that permits you to scan text and have the computer read it as if you typed it in yourself — they can make quick work of capturing text from reams of material.

Sheet Scanners Save Space

Diminutive sheet scanners are another popular choice for many. Best suited for those who need to handle just unbound documents, they take up a minimum of desk space and are easy to use. They too can be outfitted with document feeders and OCR software.

Multipurpose Suits SOHO

Recently there has also been a trend to develop and market multipurpose, or "all-in-one", devices. Combining the function of scanner, printer, copy machine, and FAX, they are a perfect solution to those with many needs and neither the budget nor space to purchase several single-purpose units.

These units are ideal for anyone with a small or home office. By using the same scanning mechanism for both FAX and regular scans, it is an economical purchase that boasts high-quality printing to boot! They are a breeze to configure since you are installing a single device, not a bunch of separate peripherals.

Special Purpose Scanners

For those who are "technology enthusiasts," specialized or single purpose scanners can also be found. Some units are designed solely to handle business cards. These may even be bundled with software to manage professional contacts with a mail and database application. These products make great sense if your needs are specific and you don't want to spend money for features that will never be used.

Software is Important

Software is a critical and integral part of scanner operation. The software is responsible for both the actual control of the scanner hardware and for the manipulation of the images once they have been acquired. Most scanners will have software bundled with them from the manufacturer.

Many times the bundled software contains full-blown versions of popular applications such as Adobe Photoshop. Sometimes the software will be "light" or limited edition programs. These may be sufficient for most users but can typically be upgraded to more capable versions if the need demands it. Of course you can also purchase specialized software to go along with any scanner you buy.

Experienced users will check for the scanner to be TWAIN-compliant. This is an industry standard method for application programs to communicate with a scanner directly. This capability is vital for anyone interested in serious desktop publishing and graphic design.

Scanner Test Drive

Here are a few tips to remember when researching your scanner purchase:

1. Make sure when evaluating any scanner that you try scanning some materials that you will typically use. Bring some representative samples of the materials you want to scan. How difficult is it to feed documents?
2. Get a feel for the software and how easy it is to control. Is the interface intuitive?
3. Check the file types that the software can work with so that

you can share your scanned files with a wide variety of applications. TIFF, JPEG, and GIF are some of the most universally supported formats.

4. Closely examine the scans you get and judge the results. Scan quality is both a subjective and objective rating. Compare the scans to the originals. Check for details and color accuracy.

5. Clock scan time and gauge how noisy the system gets.

Scanners can open up a whole new world with your computer so experiment and have lots of fun!

Rating Performance

Scanner capability is measured in a variety of ways. *Optical resolution* is the measurement of how many readings can be taken over a given area. A resolution of 300x300 DPI means that the scanner is capable of taking 300 distinct measurements per inch in one direction, or 90,000 readings per square inch.

Another commonly quoted specification is *interpolated resolution*. Scanners will insert additional pixels into a scan by assigning a value to a point between the actually scanned pixels. Be aware that the more data you try to capture, the larger the resulting files will become. Oversampling can eat up huge chunks of disk space with little gain in actual image quality.

Bit depth is a critical factor to consider when judging a scanner's quality. Color scanners will gather data independently for the red, blue and green spectrums. The number of bits per pixel reveals how precise the scanner can be. A 24-bit scanner, for example, is capable of collecting 8 bits of data for each color scanned. More expensive scanners can capture 30 or 36 bits of information per pixel. Again, the more data you capture, the larger the resulting image file becomes.

Optical density is a measurement of the dynamic range of the scanner sensors. It is the capability of the scanner to discern between the darkest and lightest tones on the originals. A wide dynamic range will help greatly when dealing

with images that have lots of subtle shading and half tones.

Making the Connection

Scanners can connect to your computer with a wide variety of interfaces. SCSI (small computer system interface), parallel port, and the newer USB (universal serial bus) are the ones most typically used.

SCSI is the oldest interface used for scanning and was made popular with the introduction of the Apple Macintosh over ten years ago. Since the Macintosh was the original computer of choice for the desktop publishing professional, many of the more expensive and capable scanners will use this interface. It has the benefit of being fast but may require the purchase of an optional SCSI card for your computer. Some scanners will include a card as part of the purchase price.

Parallel or printer port scanners are widely supported with most sheet and entry-level flatbed scanners. You won't have to install anything in your computer to use them, so setup is a breeze. Most will allow you to continue to use your printer with a passthrough port.

USB is the newest option, and scanners that use this interface are steadily being introduced by manufacturers. With the promise of easy setup and good performance, they are sure to appeal to those with the newest computers.

The bottom line is that scanners can enhance your work — both personally and professionally. Be creative!

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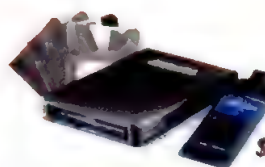
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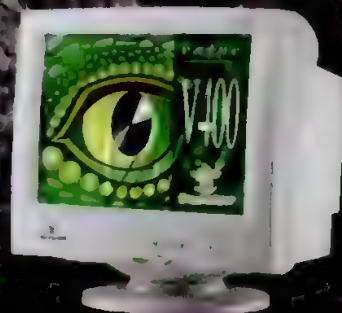
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SYSTEMS



User-to-User

BY NEIL J. RUBENKING

Changing the Default Action For Batch Files

Your March 10, 1998, *Solutions* column showed how to customize Windows 95 so that double-clicking a BAT file will open the file for editing instead of running it. I believe my method is a bit easier and more straightforward: Launch RegEdit, locate the key HKEY_CLASSES_ROOT\batfile\shell, and change its default value to Edit, Open, Print.

This technique also serves as an excellent way to change the default behavior of REG files, minimizing the risk of inadvertent registry updates. Just replace batfile with regfile and repeat the process.

GREGORY MAY
Brecksville, Ohio

PC MAGAZINE: You can adjust the actions of most file types through the Windows Explorer View | Options dialog. However, the registry applies warning flags to certain essential file types, including DOS batch files, and thus prevents you from editing them through Explorer. The earlier item explained how to remove this protection from the batch file type, change the default action to Edit, and then restore the protection. The net result of applying this tip was to change the default value of the shell key for batch files, as described above. This reader cleverly decided to skip the intermediate steps and change that value directly!

Two tiny REG files can help you use this technique without ever opening RegEdit. To change the default action for batch files, create a file containing the following lines:

```
REGEDIT4
[HKEY_CLASSES_ROOT\batfile\shell]
@="Edit, Open, Print"
```

Then save the file as Batedit.reg. Double-click the file in Explorer to launch it. Now double-clicking a BAT file will invoke its Edit action (by default, that involves loading it into Notepad). Now create Batnorm.reg using the following lines:

```
REGEDIT4
[HKEY_CLASSES_ROOT\batfile\shell]
@=""
```

If you decide you want to restore the default action for batch files to Open, just launch Batnorm.reg by double-clicking it in Explorer.

Note that this change has no effect on

launching batch files from the command line or from other batch files. Whether you invoke the batch file directly or with the START command, it will execute normally. Changing the default action affects what happens only when you double-click the file's icon in Explorer.

Protecting Your Shortcuts

One of my Zip disks is filled with my kids' games, which they access through Microsoft Windows 95 shortcuts that point to the Iomega Zip Drive. Occasionally, however, we make the mistake of pressing a shortcut when there's no disk or the wrong disk in the drive.

If there's no disk in the Zip Drive, you get a useful message and nothing harmful happens. But if the wrong disk is in the drive, there's a problem. The shortcut facility in Windows 95 deals with missing files by searching for a file with similar characteristics and prompting you. One of the most prominent characteristics is the file's creation date and time. Windows looks for the file, then prompts you with the message shown in Figure 1.

If you answer no to this message, you can't run the game or application, but no permanent changes will be made. If you answer yes, however, Windows 95 will permanently change the shortcut to point to the new file, even if that new file has nothing to do with the original application. This permanent change is implied but not directly stated by the question at the end. Most people would not realize this until it happened to them several times—as it did to me.

This happened most often to my children

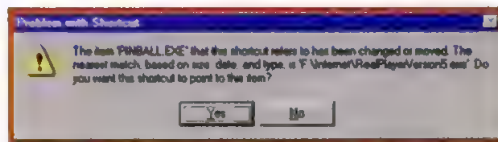


FIGURE 1: When Windows can't find the file linked to a shortcut, it proposes a "nearest match," which may be totally unrelated.

when they were attempting to play games. Kids usually just want to get on with it so they click on Yes. As a result, their shortcuts were permanently changed to point to strange files. The next time someone wanted to play these games the shortcuts did not work, even if the correct disk was in the Zip Drive. I then had to re-create each shortcut so that it pointed to the original program file.

I investigated several options to permanently solve this problem, including the use of a launcher program located on the C: drive that was smart enough not to launch an application

if it didn't find the program. The best solution was actually much simpler. I turned on the read-only attribute of shortcuts that point to applications on removable disks. Now the above messages still appear, warning us when the appropriate disk is not in the Zip Drive. I have educated my children to click the No button, but even if they click Yes the shortcut is not permanently changed, although a new program is started. The next time the correct disk is in the drive it works fine.

MICHAEL ARON
West Hartford, Connecticut

PC MAGAZINE: Each shortcut on the desktop or in the Start menu stores the full pathname of the file to which it is linked. When you launch the shortcut, Windows checks to be sure that file exists. If the file does not exist (perhaps because it was moved or renamed), Windows starts an elaborate search process that only occasionally finds the correct file.

First, Windows looks for a file in the same folder, with the same creation time and attributes but a different name. When the target file has been renamed, this process may restore the link. If no matching file is found, Windows goes through all the subfolders of the current folder, and through their subfolders as well, searching for a file with a matching name or creation time. If that fails, Windows asks you to help.

The problem is, this process frequently turns up a file that has no connection to the original shortcut except for a matching creation time. Windows blithely informs the user that this is the "nearest match" and asks whether to change the shortcut to match. The default answer is Yes, and many users will assume Windows found a correct match. On a system whose shortcuts all point to files on fixed drives, this searching process doesn't occur often, and when it does, it frequently finds a renamed or moved file.

But when shortcuts point to files on removable drives it's very easy to trigger the search, and the result is almost invariably wrong.

It's a very good idea to make any shortcuts that point to files on removable drives read-only. For those on the desktop, right click the shortcut, choose Properties from the pop-up menu, and check the Read-only box on the General tab. If the shortcut is in the Start menu, right click the Start button, choose Explore, and navigate through the menu folders until you find the shortcut. Then apply the read-only attribute just as you did for desktop shortcuts.

Ask Our Advisors

HARDWARE

Grabbing a Groove

I would like to record a snippet from an audio CD to jazz up my sound scheme. I can play the CD on my computer, but Sound Recorder in Microsoft Windows 95 does not capture the sound. Do you have any ideas on how I can do this?

V.J. FERGUSON
via the Internet

PC MAGAZINE: Adding a short clip of your favorite music is a great way to customize your Windows installation. You should be able to capture the sound using Sound Recorder; the application should be able to capture any sound that you play through your sound card. You can also do so using a shareware program. To find one, go to www.hotfiles.com and check out the Graphics and Multimedia section for the latest offerings. Two such products are CD Worx, from Cyberdyne Software, and Digital Audio Copy, from Christoph Schmelnik.

It is possible, however, that your problem with Sound Recorder comes from not routing the CD-audio sound signal through the sound card. CD-ROM drives typically have three connectors: power, data, and analog stereo. The power connection is the standard four-conductor plug used to power disk drives. The data connection is a ribbon cable (the number of pins varies with the type of data connection, such as SCSI or IDE). The analog audio connection is a three- or four-wire connection that carries the left and right audio channel signals and one or two ground wires.

The audio wire connects directly to the sound card, where the signal is mixed with other sound sources (such as digitized Wave and MIDI) and then sent to the speaker connections.

If your CD's audio is being passed through the sound card, then Windows' Sound Recorder should be able to capture the signal and record it. Make sure that Sound Recorder's *Audio Properties* settings are configured to use your sound card and not some other sound source, and make sure that the mixer settings for the CD-audio channels are at an appropriate level.

You may be hearing sound from an audio CD without the drive's audio connection attached to the sound card. For example, the connection may be to a separate pair of

speakers, or you can listen through a headset plugged into the jack on the front of the drive. If it turns out that your CD drive's audio connection is not attached to the sound card, and you're not able to find the correct cable to make the internal connection, you can use a stereo patch cord between the headphone jack on the drive and the line input jack (if there is one available) on the back of the sound card.

Once you have the CD drive properly connected to the sound card, you'll be ready to record your sound clip. Depending on how you intend to use the sound clip, you may want to adjust Sound Recorder's settings. The highest quality level should match the original CD quality, but this can create a very large file.

If you don't need a perfect-quality recording, you may want to choose lower settings that won't consume as much disk space. CD-audio quality uses two tracks of 16-bit samples at a rate of 44.1 kHz, which takes up 172K per second. This works out to only about 6 seconds of sound per megabyte of disk storage. By contrast, a single-track (mono) recording with 8-bit samples at a 22.05-kHz sampling rate takes up only 22K per second, and is roughly equivalent to the sound quality of a radio transmission. You can fit more than 46 seconds of this sound in a megabyte of storage space. You may want to try the recording at a number of different settings to find the smallest clip file that produces the desired sound quality.—*Alfred Poor*

OPERATING ENVIRONMENTS

Extracting Addresses from IE3's Address Book

Because of some problems, I recently had to reformat my hard disk and reinstall all my Windows 95 software. Unfortunately, after reinstalling the Microsoft Internet Mail application (I use the version that came with Internet Explorer 3.01), I wasn't able to identify the file location for the Address Book to be able to restore it from backup files. Can you help me find it? Also, I would like to print the Address Book, just in case it ever gets lost or corrupted.

RICHARD S. THIESSEN
via the Internet

PC MAGAZINE: The Windows Address Book file has the extension .WAB, and it's found in your Windows directory (usually C:\Win-

dows). The file's name will correspond to your log-on name, for example, Richard.wab. Of course, if you restore a backed-up version of this file, you will lose any addresses that may have been added since the backup.

The internal format of the file is proprietary, and not compatible with standard mailbox formats. Although address book conversion programs exist at various download sites, I haven't yet found one that will successfully export, convert, or print the IE3 address book. If getting the names and addresses into a single text file would be sufficient for your purposes, here's how you could do so.

Open the address book and create a new group named All. Add all of the addresses in your book to this group. The easiest way to do this is to click on the first name in the list, Shift-click on the last name in the list, and then Ctrl-click to deselect any existing groups. Save the All group and close the Address Book.

Choose *Options* from the *Mail* menu and make sure that *Send messages immediately* is not checked. Create a new message addressed to the All group, then switch to the Outbox and click the *Forward* button. You'll see that the forwarded message's body text contains within it a list of all the names and e-mail ad-

OUR ADVISORS

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M. David Stone is a contributing editor and the coauthor of *Word for Windows Companion, Second Edition*.

dresses in your address book, separated by semicolons. Copy this list to the Clipboard, paste it into your favorite word processor, and save it as a text file. If you just want the list as an emergency backup, that may be sufficient. If you prefer, you can clean up the formatting, put each name on a separate line, and print the list out. Be sure to delete the message to All before the next time you send and receive mail!—Neil J. Rubenking

Good Cookies

I use Internet Explorer. Every time I agree to receive a cookie, the cookie file goes into the directory C:\Windows\Cookies. The files add up pretty quickly. Is it okay to delete them all, or would that cause problems?

SHLOMO TU
via the Internet

PC MAGAZINE: Cookies were invented to help you navigate the Web. When you're connected to a particular Internet site, the server doesn't actually remember you from one instruction to the next, much less one visit to the next. But if the server sends you a cookie, it can use the information contained therein to remember your preferences, keep track of items in your shopping cart, or simply count you accurately as a single visitor.

You can definitely delete any cookies that are on your system without harm, and you can set your browser to let you refuse cookies. There are even utilities to reject cookies without your intervention. Note, though, that if you refuse all cookies you may be unable to use certain sites to their full capabilities.

For example, a discussion forum site may offer to display only messages that you haven't read, using a complex cookie to store that information. And if a site normally stores log-on information using a cookie, you'll have to enter your user name and password each time you visit. If you'd like to know more about cookies, see the article "The New Cookie Monster" (*PC Magazine*, April 22, 1997, or at www.pcmag.com/pctech/content/16/08/ir1608.001.html).—Neil J. Rubenking

Converting JPEG or GIF Files To Bitmaps

Like many others, I like to change my wallpaper often. The Web is a great source of new images, but they're all in either GIF or JPEG format. How do I convert an image I download from the Internet to a BMP file, so I can use it for my desktop wallpaper?

THOMAS THAN
via the Internet

PC MAGAZINE: If you use Internet Explorer, you can simply load the GIF or JPEG image into IE. By default, IE installs itself as the program associated with GIF files, so in most cases simply launching the image file will load it into IE. Once the image is displayed, right-click it to invoke the menu shown in Figure 1. You can choose *Save Picture as* to save it as a BMP file. Even better, the *Set as Wallpaper* menu choice saves the image as Internet Explorer Wallpaper.bmp and sets it as your wallpaper. Note that you can right-click images that you find on Web pages and invoke these two menu options without ever specifically downloading the image as a GIF or JPEG.

Netscape Communicator now does this too.

You can also use one of the innumerable graphics conversion programs available from various download sites on the Internet. Some are shareware, some are free, and almost all will perform a simple task like converting GIF or JPEG files to BMP format.—Neil J. Rubenking

WORD PROCESSING

Using Word Pro with the WordPerfect Equation Editor

I have both WordPerfect 7 and Word Pro 96 on my system. While I generally prefer Word Pro for creating documents, I much prefer the WordPerfect equation editor to Word Pro's. Is there any way to create an equation in WordPerfect and then move it to Word Pro?

KUN-WON TANG
Via ZDNet

PC MAGAZINE: One of the benefits of Windows is that it lets you tie unrelated programs together. All you need is for both programs to support OLE (Object Linking and Embedding). And since WordPerfect 7 and Word Pro 96 both provide that support, you can, without too much trouble, insert a WordPerfect 7 equation into a Word Pro document, as long as both programs are installed correctly.

The bare-bones instructions for inserting a WordPerfect equation are simple: Move the cursor to the place you want to insert the equation in the Word Pro document. Then choose *Create | Object*. In the *Create Object* dialog box, accept the default setting to *Create a New Object*. In the *Object Type* list, highlight *WordPerfect 7 Document*, make sure the *Display as Icon* check box is unchecked, and choose *OK*.

Windows will launch WordPerfect in its own window (or switch to WordPerfect if it's already running) and open a new blank document. You can create the equation

the same way you would if you were using WordPerfect without Word Pro. At this point, if you have the Word Pro and WordPerfect windows arranged so that you can see the documents in both, you'll also see the embedded WordPerfect document in the Word Pro document, complete with the equation. And the embedded document will remain as part of the Word Pro document if you close WordPerfect or just switch to Word Pro. If you

want to modify the equation at any time, you can double-click on it in the Word Pro document. Windows will open the embedded WordPerfect document, launching WordPerfect if it isn't already running.

There are one or two formatting issues to consider. By default, WordPerfect inserts the equation in a box that runs the full width of the typing area—from left to right margin—with extra space above and below the equation and with the equation centered both vertically and horizontally in the box. If that's how you want the equation to appear in your Word Pro document, there's no reason to change it. For the greatest formatting flexibility within Word Pro, however, you'll need to adjust the box size in WordPerfect to as small as possible while still showing the entire equation.

By default, the Word Pro frame will span the width of the typing area, from left to right margin, and the equation will be at the left side of the frame. The frame will also show a border that you may not want. To adjust the frame, make sure it's selected and choose *Frame | Frame Properties*. The *Properties* box will open to show the frame settings, with *Automatic Frame Sizing to Fit Contents* (along the lower edge of the dialog box) set to *Fit Graphic*. Change this setting to *None*, so you can adjust the frame height and width.

As you change the settings for frame height and width, you'll see the effect on the equation in the document, which makes it easy to adjust the frame to the right size. You'll probably also want to set *Margin on All Sides* and *Padding around border* to 0, or at least experiment with these settings to see their effects. You'll likely want to click on the first tab in the dialog box as well, and set *Lines Around*

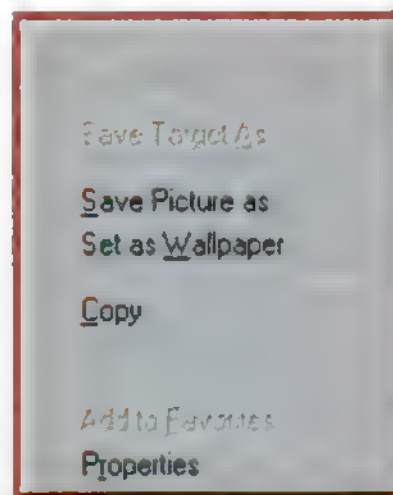


FIGURE 1: Right-click a GIF or JPEG image in Internet Explorer and this handy menu pops up.

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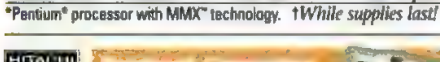
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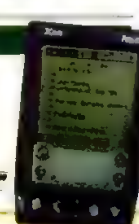
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Frame to None, particularly if you want to insert the equation within a line of text.

Finally, note that using WordPerfect to insert an equation will increase the file's size. I tried a simple test, inserting the equation "e=mc²" as text, as a Word Pro equation, and as a WordPerfect equation in an otherwise blank document. The text version was 5,176 bytes, the Word Pro equation version was 6,040 bytes, and the WordPerfect version was 11,536 bytes.—*M. David Stone*

SPREADSHEETS

Changing the Default Find Behavior in Excel 97

Ctrl-F is one of my most often-used combinations in Excel. Yet every morning when I start the program, the Find command defaults to "by Rows," despite the fact that I always want to search "by Columns" (doesn't everybody?). I know this is not a huge issue, but it is frustrating, and in spite of trying everything I can think of, I am at a loss as to how to change the default. Can you help?

ALLAN MACLEAN
New Zealand

PC MAGAZINE: In Excel 97, the following autoexecuting macro should do the trick:

```
Sub Auto_Open()  
    With Range("a1")  
        Set hoho =  
.Find(searchorder:=xlByColumns)  
    End With  
End Sub
```

Put this in a new module and save your file as a template (choose *Template* from the *Save as Type* drop-down list). Name the file "Book" and save it in your XLStart directory. Your XLStart directory must be directly below the directory that contains Excel.exe. On my system, that's C:\Program Files\Microsoft Office\Office\XLStart, but it may be different on yours.

To get the macro into a module, you can go to the *Tools* menu, choose *Macro*, then *Visual Basic Editor*. From the Visual Basic Editor's *Insert* menu, choose *Module* and in the resulting window type the macro code above.

A Book template in XLStart serves as the model for all new workbooks, including the one that Excel creates automatically at the start of a session. Because the macro is named *Auto_Open*, it runs automatically whenever a new copy of Book appears, so this should permanently change your search order default to searching by columns.—*Craig Stinson*

DATABASES

BOF and EOF Properties in Microsoft Access

When I apply the Delete method to a table-type Recordset object that contains only one record, and then apply the MoveNext method, the Recordset's EOF property becomes True but the BOF property remains False. Why is this happening, and how can I overcome it?

IRFAN SAEED KHAWAJA
via the Internet

PC MAGAZINE: The Recordset's BOF property remains False until you explicitly attempt to move the current record pointer before the beginning of the Recordset. This is happening because it's supposed to; it's defined behavior for the MS Access Jet database engine. Bear in mind the following points:

The current record pointer is not automatically relocated when you use the *Delete* method to delete a record. The record becomes inaccessible, but the current record pointer remains on the deleted record until you do something to relocate it, such as use one of the move methods (*MoveNext*, *MovePrevious*, *MoveFirst*, *MoveLast*, and so on). Neither BOF nor EOF is affected by the *Delete* method itself.

The EOF property does not become True until you attempt to position the current record pointer beyond the end of the Recordset. This occurs when you use the *MoveNext* method immediately after you delete the only remaining record. That's why the EOF property became True.

The BOF property does not become True until you reposition the current record pointer to a point before the beginning of the table. Because you never do, the BOF property setting does not change.

I assume that by "overcome it" you mean you need a reliable way to determine the number of records remaining in the Recordset so that you can detect when it becomes empty. The solution depends on whether your environment is single user or multiuser, and on the type of Recordset you create. For a single-user, table-type Recordset, you can use the Recordset's *RecordCount* property. It will contain the total number of records in the Recordset.

If you are using one of the non-table-type Recordsets (dynaset, snapshot, forward-only, or dynamic), the *RecordCount* property represents the number of records that have been visited by the engine rather than the total number of rows. Therefore to get the *RecordCount* property to reflect the total number of

rows properly, you must first use the *MoveLast* method to move to the end of the Recordset so that Access can "visit" all of the rows. (On a large Recordset this can be a slow operation, which is why Access doesn't do this automatically.) You need only do this once. Thereafter the *RecordCount* property will be properly maintained.

If your environment is multiuser and you are using a dynaset-type Recordset, you must use the *Requery* method followed by the *MoveLast* method every time you need an accurate count of the number of rows. This is the only way to take into account deletions being made by other users.

For more information on the BOF and EOF properties, see "BOF, EOF Properties" in *Microsoft Office Data Access Reference*, a part of the *Microsoft Office 97/Visual Basic Language Reference* published by Microsoft Press (Redmond, WA: 1997; ISBN: 1-57231-339-0). Another good source is Chapter 5, "Working with Records and Fields," of the *Microsoft Jet Database Engine Programmer's Guide*, Second Edition, written by Dan Haught and Jim Ferguson and also published by Microsoft Press (Redmond, WA: 1997; ISBN: 1-57231-342-0). Microsoft Press can be reached at 800-677-7377 or 206-882-8080 or via its Web site at mspress.microsoft.com.

For more information on how to determine the number of rows in a Recordset reliably, see Chapter 6, "Using Data Access Objects," in *Access 97 Developer's Handbook*, Third Edition, by Paul Litwin, Ken Getz, and Mike Gilbert, published by Sybex (Alameda, CA: 1997; ISBN: 0-7821-1941-7). Sybex can be reached at 800-227-2346 or 510-523-8233 or via its Web site at www.sybex.com.—*Sal Ricciardi*

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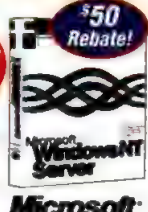
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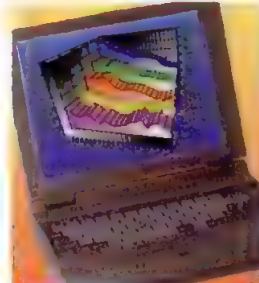


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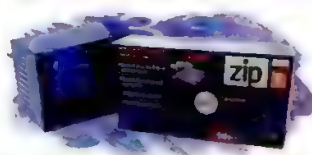


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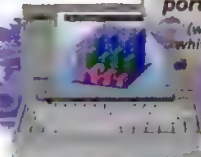
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Iiyama VisionMaster Pro 502 21" (19.5" view) 0.25mm AG 1034.14

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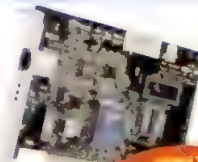
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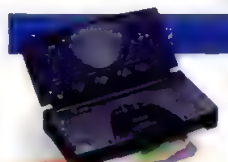
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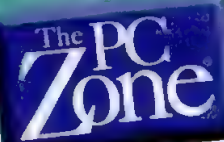
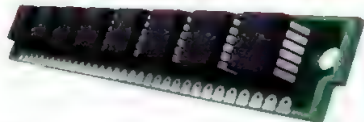
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54602	400PII/64MB/6.4GB	\$1959

IBM PC 300 PL Minitor

54606	350PII/64MB/4.2GB	\$1779
54607	400PII/64MB/6.4GB	\$1979



Inteva Desktop

100383	266MMX/32MB/3.2GB/24X/56K	\$999
100400	266MMX/32MB/3.2GB/32X	\$799
100387	266MMX/32MB/3.2GB/32X/56K	\$799

Inteva Minitor

100395	266MMX/32MB/4.3GB	\$799
100397	266MMX/32MB/4.3GB/Windows NT	\$899
100388	266MMX/32MB/4.3GB/32X/56K	\$999
100396	300MMX/64MB/6.4GB	\$999
100384	300MMX/32MB/3.2GB/32X/56K	\$799
100385	333MMX/48MB/4.3GB/32X/56K	\$899
100706	333MMX/64MB/6.4GB/32X/56K	\$999
100390	333MMX/64MB/6.4GB/32X/56K	\$1199

SONY

Sony VAIO

58143	266PII/32MB/4.3GB/24X/33.6K	\$899
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NOTEBOOKS

Acer

Acer Extensa

56677	200MMX/32MB/2.1GB/20X/12.1" DS	\$1249
56678	200MMX/32MB/2.1GB/20X/12.1" Act.	\$1479

COMPAQ

Compaq Armada

46126	166MMX/16MB/2.1GB/20X/12.1" TFT	\$1085
53398	200MMX/32MB/3.2GB/20X/56K/12.1" HPA	\$1749
50508	233MMX/32MB/3.2GB/20X/56K/12.1" TFT	\$1905
46040	233MMX/32MB/3GB/20X/33.6GB/12.1" TFT	\$599
54542	233MMX/32MB/3GB/20X/33.6GB/12.1" TFT	\$599
48850	233MMX/32MB/4GB/20X/33.6GB/12.1" TFT	\$899
58995	233PII/32MB/4GB/24X/56K/12.1" TFT	\$2399
53399	266MMX/32MB/4GB/20X/56K/13.3" TFT	\$3199
50574	266MMX/32MB/4GB/20X/33.6GB/12.1" TFT	\$2399
55275	266PII/64MB/5GB/20X/33.6GB/13.3" TFT	\$4199

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57398	233MMX/32MB/3.2GB/24X/56K/12.1" HPA	\$1499
57399	266MMX/32MB/3.2GB/24X/56K/12.1" HPA	\$1799
57000	266MMX/32MB/4GB/24X/56K/12.1" HPA	\$2099
57001	266PII/64MB/4GB/24X/56K/12.1" TFT	\$2799
58296	266PII/64MB/4GB/24X/56K/13.3" TFT	\$2999

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56427	200MMX/32MB/3.2GB/20X/56K/12.1" TFT	\$1599
56428	266MMX/32MB/4GB/20X/56K/12.1" TFT	\$1799
46036	233MMX/32MB/5.0GB/20X/56K/13.3" TFT	\$2699
161190	266MMX/32MB/5.0GB/24X/56K/13.3" TFT	\$3299

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58356	266MMX/32MB/3.2GB/20X/56K/12.1" TFT	\$1499
58500	266MMX/32MB/3.2GB/24X/56K/12.1" TFT	\$2199
100113	266MMX/64MB/4GB/24X/56K/13.3" TFT	\$3199

IBM

IBM ThinkPad 380

44922	166MMX/16MB/2.1GB/12.1" HPA	\$1299
44923	166MMX/16MB/3GB/12.1" Act.	\$1699
101585	233PII/32MB/4GB/24X/13.3" Act.	\$2449
101586	300PII/32MB/4GB/24X/13.3" Act.	\$2999
101639	300PII/32MB/4GB/24X/13.3" Act.	\$3299

IBM ThinkPad 560

41591	166MMX/16MB/2.1GB/12.1" Act.	\$1249
101593	233PII/32MB/4GB/24X/56K/13.3" Act.	\$2599
101594	300PII/64MB/6.4GB/56K/12.1" Act.	\$3599
101595	300PII/64MB/6.4GB/56K/12.1" Act.	\$3899

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54590	266PII/32MB/4GB/24X/56K/13.3" Act.	\$3499
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101583	300PII/64MB/8.1GB/56K	\$5299
101584	300PII/64MB/8.1GB/24X/56K	\$5199

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50797	233MMX/64MB/3.2GB/56K/11.3" Act./3lbs	\$2599
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101104	233PII/32MB/4.1GB/24X/56K/12.1" TFT	\$2429
55181	233PII/32MB/3.8GB/20X/56K/12.1" TFT	\$2529
58308	266MMX/32MB/4.1GB/20X/56K/12.1" HPA	\$1599
58309	266MMX/32MB/4.1GB/20X/56K/12.1" TFT	\$1899
55179	266PII/32MB/3.8GB/20X/56K/13.3" TFT	\$2899

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40466	Mobilion HC-4500	\$789.99
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55090	Mobilion HC-4100 (Refurbished)	\$499.95
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EZC International

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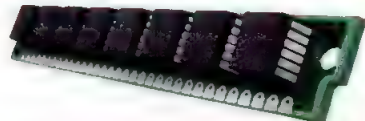
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40085	Astra 12005	\$199*
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52970	SureStore 7200L CD-Writer Plus Int.	\$389
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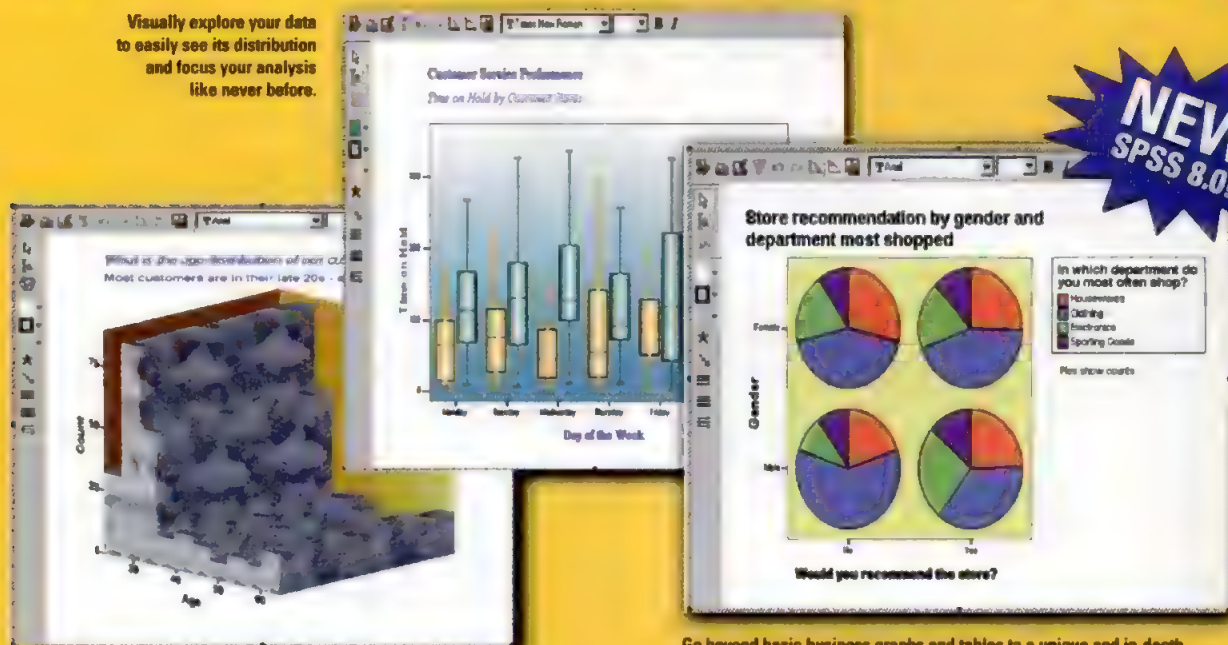
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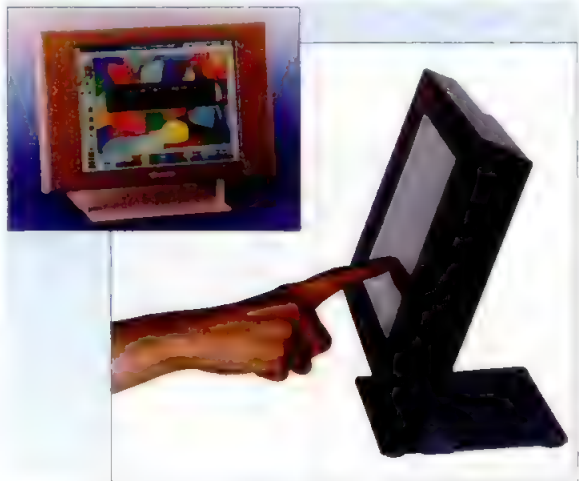
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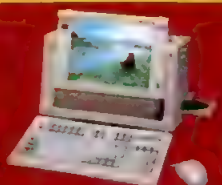
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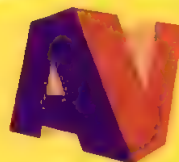


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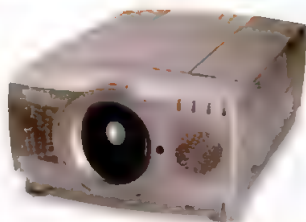
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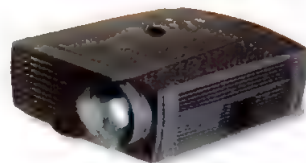


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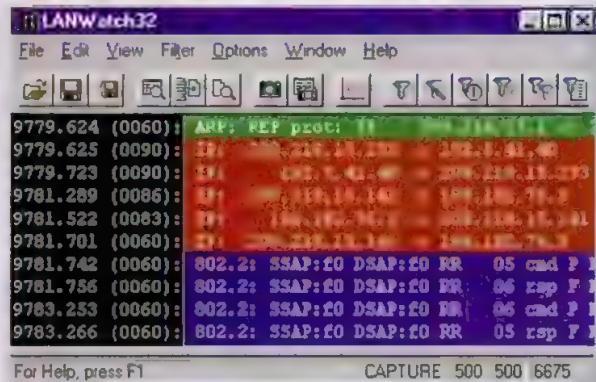


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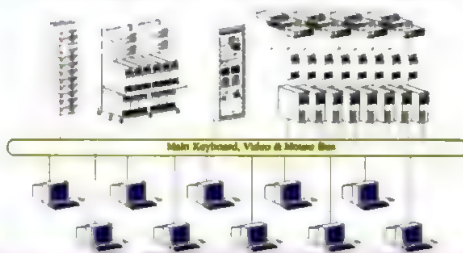
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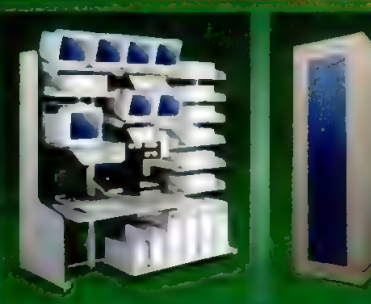
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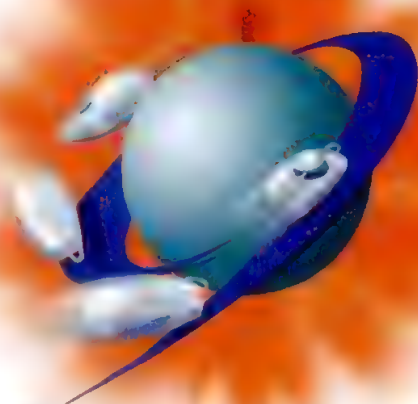
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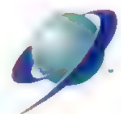
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Intel Pentium 11250 MHz	\$2349
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Intel Pentium 11650 MHz	\$2429
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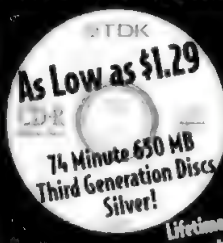
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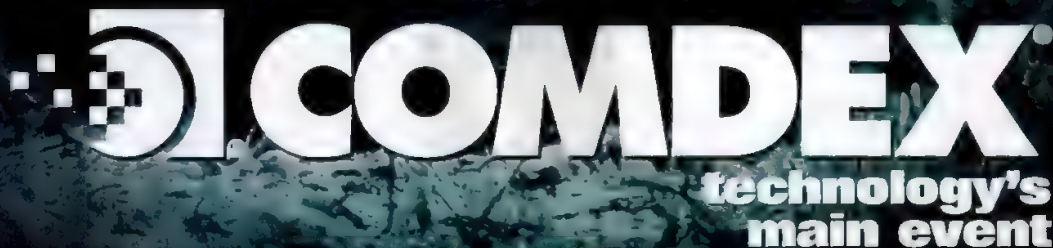
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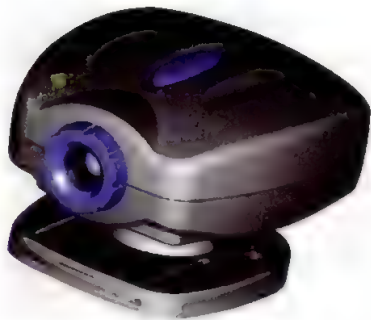
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After Hours



ULTIMATE SOFTWARE LIBRARY

Our look at the top 100 home-oriented CD-ROMs. By Jennifer Triverio

For the past several months, as all at *PC Magazine* can attest, we needed the skill and dexterity of rock climbers to traverse the mountainous stacks of software piled in our offices and make it to the (relative) safety of our desks. But it was worth the struggle because, as the 20 reviewers involved in this undertaking came to realize, there's top-notch software available for all ages and interests.

All of the several hundred submitted programs were released between June 1997 and June 1998 and were tested on the basis of installation and setup, content, suitability to task, and value. The results were tabulated and the winners appear on the following pages, divided into four categories: educational fun, games, home and hobby, and reference. The titles in Educational Fun are also divided into two age groups:

ages 9 and under and ages 10 and up. If you have a child, however, you should be sure to peruse them all, because many of the titles bridge the age ranges. Within each category, the programs are alphabetized.

You may have noticed that we've changed the name of this annual roundup (for the past four years it's been simply dubbed "The Top 100 CD-ROMs"). This change was enacted not only because it's nice to liven things up once in a while but also because it may help us usher in a new era next year when (dare we say it) DVD-ROMs might take their place on the Top 100 list of irreplaceable software.



After Hours

EDUCATIONAL FUN

AGES 9 AND UNDER

The American Girls Premiere (\$35 street; The Learning Company, 800-227-5609, www.learningco.com). Few and far between are the 7-to-12-year-old girls who haven't heard of The American Girls Collection of dolls and books. Based on the Collection's heroines (Felicity, Kristen, Addy, Samantha, and Molly), this creativity program lets girls bring the characters to life in plays that they produce. Girls can stage, cast, script, voice, and direct plays using the disk's ample props—from theme music to costumes.—*Jennifer Triverio*



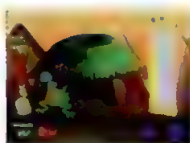
Ariel's Story Studio (\$35 street; Disney Interactive, 800-900-9234, www.disneyinteractive.com). All expectations would have been against a computer game based on *The Little Mermaid* matching in any way its magical movie progenitor, yet Ariel's Story Studio does just that. With storybook creation, reading and vocabulary lessons (disguised as fun games), and sing-alongs, the disk never grows tiresome.—*Sharon Nash*



Arthur's Computer Adventure (\$30 street; with Arthur plush doll, \$40; Broderbund Software, 800-548-1798, www.broderbund.com). Based on a popular PBS children's show, Arthur's Computer Adventure will entertain children for hours while helping them develop their reading, vocabulary, math, logic, and creativity skills. In

addition to a multimedia story about Arthur and his family and friends, called "Deep Dark Sea," Arthur's Computer Adventure has five learning activities, such as hunting for buried treasure with Arthur and playing store with DJW.—*Angela Tuka*

Awesome Animated Monster Maker Math (\$44.95 list; Houghton Mifflin Interactive, 617-503-4800, www.hmnet.com). If your grade-schoolers are haunted by math troubles, this program is a great way to take the scare out of arithmetic—from basic addition to logic problems. Your kids will be so entertained by the quirky animated monsters that they build themselves, the learning will just sneak up on them. The disk's parental controls let you customize the game for a child's specific needs.—*Adam Asch*



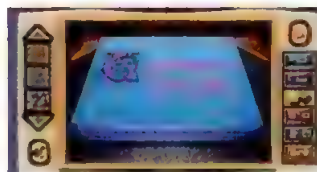
Backyard Baseball (\$39.95 list; Humongous Entertainment, 800-499-8386, www.humongous.com). Baseball sims aren't just for grownups anymore. Backyard Baseball is one of the most endearing games this side of Yankee Stadium. Kids choose from ten different playing fields, such as a sandlot or ballpark, then select their teammates, team name, and uniforms. They can even make and print baseball cards for their favorite players. Pitching, hitting, and fielding controls are easy enough for even the little ones to master.—*JT*



Barbie Magic Hair Styler (\$34.99 list; Mattel Media, 888-628-8359, www.mattelmedia.com). Barbie's been around for a half century for a reason: She knows how to captivate

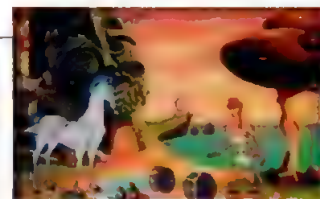
little girls: Witness the Barbie Magic Hair Styler. Girls can give new looks (including make-up and accessories) to Barbie and her pals. Favorite looks can be printed.—*JT*

Crayola Color a Story in 3D (\$29.95 list; IBM, 800-426-7235, www.us.pc.ibm.com/multimedia). If your kids like to color, Crayola Color a Story in 3D is a keeper. Not only does it narrate three classic tales—*Gulliver's Travels*, *20,000 Leagues Under the Sea*, and the story of the Trojan Horse—but it also offers 60 3-D coloring scenes, 63 Crayola colors, and 18 textures. There's also a scribe pad for creating an original work of art.—*AT*



Crayola Print Factory (\$29.95 list; IBM, 800-426-7235, www.us.pc.ibm.com/multimedia). Crayola Print Factory will inspire countless creative projects—bookmarks, stickers, paper airplanes, greeting cards, stationery, and more. For these, Print Factory offers easy-to-use tools such as markers and crayons, plus 80 Crayola colors, tons of clip art, stamps, shapes, and textures. The Print Factory creations look great printed out in color or black and white.—*AT*

Disney's Animated Storybook, Hercules (\$35 street; Disney Interactive, 800-900-9234, www.disneyinteractive.com). Last year's hugely popular animated movie character Hercules has muscled his way onto a CD-ROM. As with other Disney Storybooks, kids can read along with the narrated story or jump right into five activities. Among them



are karaoke versions of three of the movies' catchy tunes—including the surefire crowd pleaser "Zero to Hero."—*JT*

Freddi Fish 3: The Case of The Stolen Conch Shell (\$29.99 list; Humongous Entertainment, 800-499-8386, www.humongous.com). The Great Conch Shell is missing, and it's up to Freddi Fish to find it. Joined by her wisecracking best pal Luther, Freddi interacts with an eccentric cast of under-sea characters. Kids are sure to enjoy the game's inventive, cartoony style. They'll need to think logically to guide Freddi past various obstacles and solve the crime.—*Troy Dreier*



Great Adventures by Fisher Price, Wild Western Town (\$20 street; Davidson & Associates, 800-545-7677, www.education.com). Ride into town and help Deputy Prairie Dog capture Bandit Bob in Wild Western Town. The Sheriff will deputize kids to help search for Bob's stolen gold. As they look for the loot, kids can play games and sing songs with the locals using an intuitive interface suitable even for tots. They can even design and print wacky deputy badges and "wanted" posters.—*Michael N. Rusignuolo*



JumpStart Typing (\$30 street; Knowledge Adventure, 800-542-4240, www.adventure.com). Kids can go for the gold with the Olympic-style

OUR CONTRIBUTORS: Adam Asch, Glen Boisseau Becker, Gary Berline, Troy Dreier, Christina M. Evelyn, Diane Jecker, Joshua Levy, Carol Mangis, Jay Munro, Sharon Nash, Patricia Perkowski, Paul B. Ross, Michael N. Rusignuolo, Miriam Sampson, Nancy Sirapyan, Win Swarr, Angela Tuka, and S. Jae Yang are on staff at *PC Magazine*. Michael E. Ryan is a freelance writer. Jennifer Triverio was the associate editor in charge of this story.

keyboarding events in JumpStart Typing. Snowboarding, rock climbing—all the hip sports are here in the form of typing drills and exercises. A progress report charting accuracy, words per minute, and hand placement tracks kids through the program's three difficulty levels.—JT

The Little Wizard (\$29.95 list, Gizmo Gypsies, 888-464-4966, www.gizmogypsies.com). Youngsters with a yen for the mouse will be in click heaven when they embark on a journey with the Little Wizard. Travel from Eartail Forest to Bugville, making music, mischief, and general merriment. Random animations interweave with color and number games to keep kids entertained. Although it claims an age range of 3 to 8, the disk will really enchant the younger end of the spectrum.—JT



Nightmare Ned (\$35 street; Disney Interactive, 800-328-0885, www.disneyinteractive.com). There are demons in the doctor's office and phantoms in the attic. Welcome to Ned's nightmare, a loopy dream world where Ned, armed with a red yo-yo, takes aim at his fears. Created by Disney Interactive, this game is so packed with great graphics and original songs that it makes other kids' titles look anemic by comparison.—TD

Print Artist's Craft Factory (\$30 street; Sierra, 800-757-7707, www.sierra.com). Designed for kids of all ages, Print Artist's Craft Factory is an engaging program with which kids



can create all kinds of crafts—like greeting cards, banners, stickers, board games, masks, and stationery.

The multimedia interface is easy enough for a young child to use, and the numerous projects and graphics will maintain your child's interest for years.—Diane Jecker

Schoolhouse Rock Essentials Series (each disk, \$34.95 list; Creative Wonders, 800-543-9778, www.creativewonders.com). Join Interplanet Janet and the rest of the "Schoolhouse Rock" characters in this series of math, science, social studies, and reading CD-ROMs for first-through fourth-graders. Games and experiments challenge your kids, and you can set the pace using the parents' guide. Kids can also play one of the many "Schoolhouse Rock" videos. Admit it: This is where you learned how a bill becomes a law.—AA



Sesame Street: Reading Is Fun Toddler Edition (\$35 street; Creative Wonders, 800-543-9778, www.creativewonders.com). What better way to learn to read than with the classics—well, almost. Elmo, Big Bird, and the gang take kids ages 2 to 4 through Grover's Travels and The



Three Grouchkeeters, where kids explore rhyming, counting, and shape recognition. The original "Sesame Street" songs and 12 activities are sure to entertain, and the parent's guide lends a hand to the grownups.—JT

Spy Fox in "Dry Cereal" (\$39.95 list; Humongous Entertainment, 800-499-8386, www.humongous.com). In this adventure story, kids meet a fox who acts like Secret Agent 007. Though he's smooth and knows every trick in the book, Spy Fox needs your child to help him foil Evil William the



Kid's plan for world domination. Tons of clickable animations and crazy characters will delight kids—and parents, too.—JT

Thinkin' Things Sky Island Mysteries (\$29.95 list; Edmark, 800-691-2985, www.edmark.com). As evidenced by the number of detective-type programs in our Top 100 list, kids love a good mystery. Sky Island Mysteries is designed to teach kids ages 8 to 12 critical thinking, deductive reasoning, and logic—all as they solve 14 whodunits. There are dozens of skill levels, so the puzzles, riddles, and rebuses become more difficult as play goes on.—JT

AGES 10 AND UP

Acing the New SAT (\$30 street; Princeton Teaching Associates Software, 888-278-2832, www.ptas.com). Taking the SAT is a major step in a young adult's life, and as with any momentous occasion, there's a software package for it. Acing the New SAT instills confidence through its organized though still "cool" teaching style. Learning takes place in a building where kids graduate to the next level, or floor, as they master math and verbal skills. Practice tests keep kids tuned in to their progress.—JT

The Adventures of Valdo & Marie (\$30 street; UbiSoft Entertainment, 800-824-7638, www.ubisoft.com). For inquiring young adults, The Adventures of Valdo & Marie offers a highly entertaining learning environment. Based on actual 16th-century overseas journeys, the disk is chock-full of navigational lore. Players follow Valdo and Marie on their travels, guiding them through ten puzzle activities and six strategy games. The characters' adventures can lead to nine different endings, ranging from abject poverty to wealth.—SN



Carmen Sandiego Math Detective (\$35 street; Broderbund Software, 800-548-1798, www.broderbund.com). The inexhaustible Carmen is out to shrink the world's treasures, and kids must employ all their math savvy to put an end to the chaos. Essential math, geometry, and word problems are covered in the game's thousands of drills and problems. Three levels of difficulty ensure that your child will be wearing a sleuth cap for years to come.—JT

Grade Builder Algebra 1 (\$29.95 list; The Learning Company, 800-227-5609, www.learningco.com). Okay, this may not be the first title kids reach for, but they'll be glad they have it after those math test scores start improving. Kids select the textbook they use in class from a list of 20 of the most popular (additional choices are available for download at the Web site), and the disk's content adjusts to match their book, lesson by lesson.—JT



Grossology (\$29.99 list; SegaSoft, 888-734-2763, www.segasoft.com). When was the last time you found something totally disgusting, yet you wanted to experience it again and again? Grossology, designed to teach kids about the human body, fills this bill nicely (actually, not so nicely). Snot, zits, scabs, and barf are but a few of the topics covered in the game's nine exploratory labs and nine games.—JT



Math Blaster Ages 9-12 (\$29.95 list; Davidson & Associates, 800-545-7677, www.education.com). In this edition of the highly effective Blaster series, kids take on the role of a traveler who must find a medallion

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for a strange world's ruling deity. Math is the key to conquering each challenge that presents itself along the way. From fractions to common denominators, Math Blaster's 50,000 different problems have the area covered. Written and oral instructions provide extra help if needed. —Win Swarr



The Oregon Trail 3rd Edition: Pioneer Adventures (\$50 street; The Learning Company, 800-227-5609, www.learningco.com). Ever wonder what it was like to be a pioneer in the Old West? Find out by leading a wagon train in The Oregon Trail's latest installment. You plan every part of the trip, from supplies to traveling companions to your route. And if you happen to get into trouble on the way, a handy guide book will help see you through. —MNR



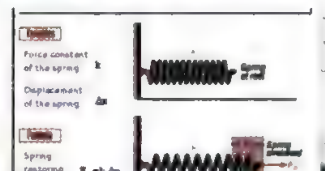
Rockett's New School (\$25 street; Purple Moon, 888-278-7753, www.purple-moon.com). Being the new girl on the block can be a challenging experience. That's what Rockett Movado discovers as she begins the eighth grade in Rockett's New School, one in a series of top-notch programs for girls ages 8 to 12. Players help Rockett meet new classmates and make new friends. Girls can choose from numerous story lines to help make or break Rockett's day. —Christina Evelyn

Small Soldiers Squad Commander (\$39.95 list; Hasbro Interactive, 800-400-1352, www.hasbrointeractive.com). Based on the animated film *Small Soldiers*, Squad Commander is a strategy game that puts kids in charge of a unit made up



of either commando soldiers or beastlike Gorgonites. Featuring sharp graphics and the voices of Tommy Lee Jones and other actors from the movie, Squad Commander provides thought-provoking fun, action, and challenging puzzles throughout. —AA

StudyWorks! Science (\$35 street; MathSoft, 617-577-1017, www.mathsoft.com). After one look at



this exceptional educational software, you'll be lamenting the fact that it wasn't available when you were in high school. Covering earth science, biology, chemistry, physics, and statistics, StudyWorks! sets out to demystify its topics through clear, detailed explanations and examples. Its Resource Center is also top-notch, with continuously updated material from the Web. More good news: There's a math version of StudyWorks!, too. —JT

Where in the U.S.A. Is Carmen Sandiego Deluxe Edition (\$35 street; Broderbund Software, 800-548-1798, www.broderbund.com). Kids don the persona of an ace investigator to track master thief Carmen Sandiego through the 50



states and put an end to her mischief (she's been ruining the country's national monuments). Along the way, they're bound to uncover a slew of facts about the cities, states, and regions of the U.S. Detailed maps, a multimedia library, and Internet resources will help in the mission. —JT

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GAMES

Age of Empires (\$55 street; Microsoft Corp., 800-426-9400, www.microsoft.com). Age of Empires is an intriguing real-time strategy game that combines the complexity of Sid Meier's Civilization with the frenetic pace of Command & Conquer. Leading one of 12 ancient civilizations, you must build up your city and conquer rival nations. The graphics and multiplayer support are both top-notch. As with M1 Tank Platoon II, however, we recommend you play this game with the latest patch installed.—*Michael E. Ryan*

The Curse of Monkey Island (\$50 street; LucasArts Entertainment Co., 888-532-4263, www.lucasarts.com). This beautifully animated adventure game is the third installment of the classic Monkey Island series. The player must help would-be pirate Guybrush Threepwood rescue his beloved Elaine from the evil clutches of LeChuck, the zombie pirate who just refuses to stay dead. Game play,



as with any adventure game, involves a lot of puzzle solving, but the puzzles in this game are as funny as they are challenging.—*MER*

Descent: Freespace (\$50 street; Interplay, 800-468-3775, www.interplay.com). Light years ahead of the original Descent titles, Descent: Freespace is a space combat game that offers first-class single and multiplayer game play. As a Terran pilot, you embark upon a series of missions against an old enemy, only to discover that a powerful new enemy has emerged to challenge both sides of the conflict. To cap things off, the game also includes a comprehensive campaign editor.—*MER*

Dungeon Keeper (\$50 street; Bullfrog/Electronic Arts, 800-245-4525, www.bullfrog.ea.com). In Bullfrog's Dungeon Keeper, you control an underground fortress of malignance, populated with monsters and demons. To win, you must develop your lair into a bigger, more formidable locale while fending off attacks from do-gooder heroes intent on plundering your gold. Sure, the game has a dark theme, but it's incredibly funny and very addictive, particularly in multiplayer mode.—*MER*

F-15 (\$55 street; Jane's Combat Simulations/Electronic Arts, 800-245-4525, www.janes.ea.com). Designed by Andy Hollis, who brought us the classic F-15 Strike Eagle, F-15 is a state-of-the-art jet combat simulator. The game lets you take part in "instant action" missions, as well as two full-scale campaigns: a re-creation of Desert Storm and a hypothetical conflict in Iran. F-15 offers an amazing 3-D graphics engine, adjustable difficulty levels, and multiplayer support. Like Descent: Freespace, F-15 includes a mission editor.—*MER*



Fallout (\$50 street; Interplay, 800-468-3775, www.interplay.com). Fallout's combination of cutting-edge graphics and classic-style game play is a welcome addition to the world of PC role-playing games. Set in a postapocalyptic world, Fallout challenges players to complete a series of quests while surviving such unpleasantities as mutant attacks, radiation, and gangs. The turn-based style of play hearkens back to the good old days of PC role-playing games.—*MER*

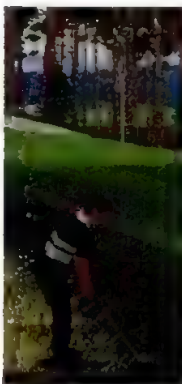
Final Fantasy VII (\$50 street; Eidos, 800-617-8737, www.eidos.com). Having begun life on the Sony PlayStation, Final Fantasy VII is virtually identical to its console cousin. Leading an unlikely hero named Cloud



Strife, you must help thwart the planet-dominating schemes of a corporation called Shinra. The game's beautiful 3-D graphics and fast-paced, real-time combat are enhanced by a fascinating and complex story line.—*MER*

Hexen II (\$26.95 list; Activision, 310-255-2000, www.activision.com). One of many sequels in this year's Top 100, Hexen II is a first-person action game with a smattering of role-playing elements. For example, you can choose the type of character you want to play, and you'll gain special abilities as you progress through the game. Your goal is to thwart the plans of the last great Serpent Rider, Eldon, and his minions, the Four Horsemen of the Apocalypse.—*MER*

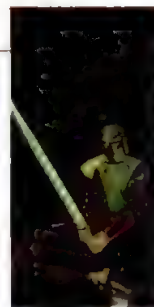
Jack Nicklaus 5 (\$39.95 list; Accolade, 800-245-7744, www.accolade.com). Featuring ten richly detailed golf courses, 3-D polygonal players, and a slew of camera angles from which you can view the action, Jack Nicklaus 5 has plenty of eye candy.



But this game goes a lot deeper than looks. For starters, it offers a phenomenal golf-course design utility, three different control methods for swinging your virtual club, and compatibility with hundreds of free, downloadable golf course files.—*MER*

Jedi Knight: Dark Forces II (\$50 street; LucasArts Entertainment Co., 888-532-4263, www.lucasarts.com). The second installment of the Dark Forces series will be remembered as one of the best action games ever.

You again play Kyle Katarn, attempting to learn the ways of the Jedi and avenge your father's death while battling endless waves of storm troopers. What really sets this game apart is its unparalleled level designer.—*MER*



M1 Tank Platoon II (\$50 street; Microprose, 800-695-4263, www.microprose.com). M1 Tank Platoon II is a superlative simulation of modern tank combat. Boasting an impressive 3-D graphics engine, the game puts you in command of a four-tank platoon and a wealth of supporting forces as you tackle campaigns all over the world. One caveat: We strongly recommend that you download the game's latest patch, which corrects a number of problems with the original release.—*MER*

Might & Magic VI: The Mandate of Heaven (\$49.95 list; The 3DO Company, 800-336-3506, www.3do.com). Might & Magic VI is an old-fashioned game of hack and slash. Leading a party of four through the turbulent world of Enroth, you must complete a complex series of quests to free the land of a powerful evil force. 3-D graphics and first-person perspective immerse you in the fantasy setting, while the open-ended nature of the story lets you proceed at your own pace.—*MER*

Myth: The Fallen Lords (\$49.95 list; Bungie Software, 800-295-0060, www.bungie.com). A great-looking and extremely challenging game of real-time tactical combat, Myth challenges players to lead the forces of Light against the Fallen and the forces of Dark. Over the course of 25 missions, you will command your human and elfin troops over 3-D rendered battlefields, each viewable from



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virtually any angle via the free-floating camera controls. Multiplayer support is solid and allows several variations on game play.—MER

NBA Live 98 (\$50 street; EA Sports/Electronic Arts, 800-245-4525, www.easports.com). For PC sports fans with a passion for hoops, NBA Live 98 is the ultimate gaming title. With spectacular 3-D graphics and fast, furious slam-dunk action, as well as loads of moves that let you showboat in the paint, this game does a great job of re-creating a game-time atmosphere. You can take your favorite team to the NBA Finals or draft a dream squad.—MER

NHL 98 (\$50 street; EA Sports/Electronic Arts, 800-245-4525, www.easports.com). NHL 97 made our previous Top 100 list because of its outstanding graphics engine and intense game play. This year, NHL 98 builds on that foundation by adding even better graphics, more realistic game play, and lots of new coaching options. Players can take part in exhibition, season, and playoff competitions. You have complete control over your team's on-ice performance, including every slap shot and line change.—MER

Quake II (\$50 street; Activision, 310-255-2000, www.activision.com). First came Doom, Doom II, and Quake—classics all. But the latest effort from developer id Software puts them all to shame. The single-player game is top-notch; the fast-paced fury of the game's multiplayer Deathmatches is beyond compare; and the 3-D graphics are phenomenal. Even the story is entertaining. After years of defending human turf from alien invasion, you finally get to join an invasion force bound for the alien home world.—MER



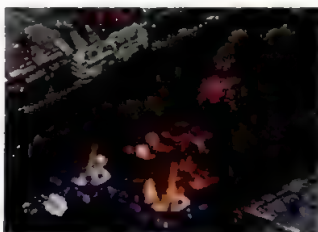
Riven: The Sequel to Myst (\$60 street; Red Orb Entertainment, 415-382-4400, www.redorb.com). Riven

delivers even more engrossing game play than the original Myst. Players are recruited by Atrus to search the world of Riven for his missing mother and father. The puzzles, though more difficult than those in Myst, are much better integrated into the story. The game also features improved graphics and even some full-motion video. Basically, Riven is all that Myst was and more.—MER

Sid Meier's Gettysburg! (\$55 street; Firaxis/Electronic Arts, 800-245-4525, www.firaxis.com). Sid Meier's Gettysburg! is a fabulously detailed simulation of the most dramatic conflict of the American Civil War, with exquisitely detailed battle maps, well-animated unit graphics, and incredible replay value. You can customize the difficulty level to suit your inclination and choose to play through a series of historical, hypothetical, or random engagements. Multiplayer support allows up to eight players to participate in the battle.—MER



Starcraft (\$50 street; Blizzard Entertainment, 800-953-7669, www.blizzard.com). The follow-up to Blizzard's Warcraft series, Starcraft is a real-time strategy game that improves upon an old formula with a variety of new features. The game is split into three chapters. You begin as the leader of human forces, but you'll also command the insectile Zerg and enigmatic Protoss species. Excellent graphics, fast-paced game play, and intense multiplayer action highlight this winner.—MER

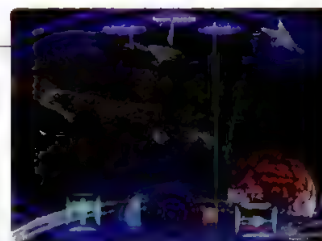


Tomb Raider 2 (\$50 street; Eidos, 800-617-8737, www.eidos.com). Lara Croft is back in this sequel to one of the most popular games of 1997. Lara's quest will take players through China, Venice, Tibet, and even a sunken ship. This third-person game plays very much like the original, with a few notable improvements, such as dynamic lighting, new weapons, and smoother controls. Also, the developers were gracious enough to give perennially underdressed Lara a bomber jacket for her travels.—MER

Total Annihilation (\$49.95 list; Cavedog/GT Interactive, 800-469-5961, www.cavedog.com). Total Annihilation is a breath of fresh air in the real-time strategy genre, with outstanding terrain and unit graphics that go beyond the typical 2-D bitmap fare. You'll also find 150 different unit types in this game, with more available for download. Add to this mix incredibly addictive game play in both single and multiplayer modes, and you have one of the best real-time strategy games ever.—MER

Unreal (\$50 street; GT Interactive, 800-610-4847, www.gtinteractive.com). Unreal has come to be equated with amazing graphics. Though the game's multiplayer action isn't up to the standard of Quake II, the graphics are definitely on a higher plane than in most games. To see this game in all its glory, however, you need a high-end Pentium II with a 3-D accelerator. You begin the game as a captive aboard a crashed prison ship. Stranded on a hostile alien world, you must fight your way off the planet and find your way to safety.—MER

Wing Commander Prophecy (\$50 street; Origin Systems/Electronic Arts, 800-245-4525, www.origin.ea.com). The latest in the impressive line of Wing Commander titles, Prophecy offers great graphics and exciting game play. Again assuming the role of a hotshot young very rookie pilot, you must take to the skies to defeat a seemingly unstoppable enemy. A dazzling array of 3-D effects and the



detailed, buglike enemy ships are just two highlights of this gripping game. As do earlier versions of the series, this latest title uses well-produced full-motion video sequences to advance the story.—MER

World Cup 98 (\$50 street; EA Sports/Electronic Arts, 800-245-4525, www.easports.com). With an incredible 3-D graphics engine and realistically animated players, World Cup 98 is quite possibly the best sports game we've ever played. You pick one of 48 teams and try to lead



them to the championship, playing either this year's field or a randomly generated tournament. The game also includes a series of vintage match-ups, starting with the 1982 contest between Italy and West Germany.—MER

Worms 2 (\$29.99 list; Microprose, 800-695-4263, www.microprose.com). One of the simplest, funniest, and most addictive games we've seen in a long time, Worms 2 puts you in control of a team of heavily armed worms. You must bump off your opponent's worms to win. Cartoon-style graphics and humorous dialogue highlight the action. You can play against up to 5 other players over a LAN or the Internet, but the real fun comes in an 18-player "hot-seat" game played on a single computer.—MER



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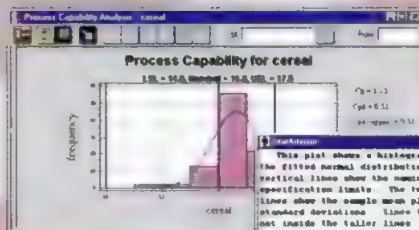
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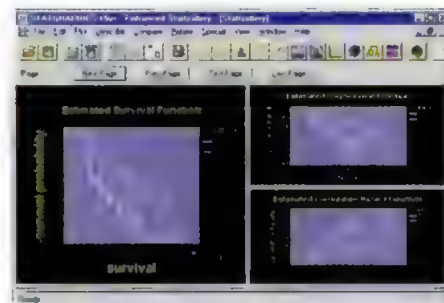
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This plot shows a histogram of cereal together with the fitted normal distribution. The three taller vertical lines show the nominal values and the specification limits. The two shorter vertical lines show the sample mean plus and minus 3.0 standard deviations. Since the shorter lines are not inside the taller lines the process would be deemed to be incapable of meeting the specs. The area under the fitted distribution outside the specification limits equals 0.943197, implying that an estimated 94.3197% of the distribution would be out of spec.



After Hours

HOME AND HOBBY

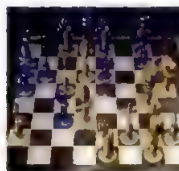
AuraLine Multimedia Creation Kit (\$49.95 list; NEC Systems Laboratory, 888-223-4385, www.auraline.com). Spicing up your Web site with Java-enabled animations and effects requires no knowledge of scripting—and no plug-ins—with AuraLine. A timeline and page layout give you a clear overview of your work in progress, and the media library includes more than 5,000 Java and GIF animations, 3-D images, sounds, and backgrounds.—JT

Calendar Creator 5.0 (\$60 street; The Learning Company, 800-227-5609, www.learningco.com). Most of us could stand to be a little more organized, and using Calendar Creator is a step in the right direction. You can track your hectic schedule on a calendar and to-do list that you can



customize—from the layout right down to the color of the typeface. Calendars can be integrated with the program's address book, and the information can also be downloaded to your PalmPilot.—JT

Chessmaster 5500 (\$39.95 list; Mindscape, 800-234-3088, www.mindscape.com). Chessmaster 5500 is an all-encompassing chess experience that infuses the player with the excitement of learning and winning. Before you play, fine-tune your board, your opponent, and the game's amazing mentoring tools. These include a multimedia natural-language analysis of your game, quick hints, a detailed strategy guide, and a merciless rating program once the battle is over. To play a person instead of the program, choose Web-based play.—Paul Ross



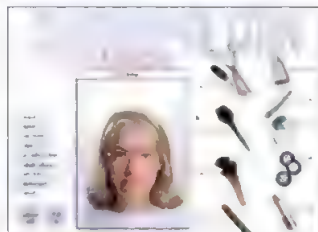
Complete Land Designer (\$50 street; Sierra On-Line, 800-757-7707; www.sierra.com). Landowners, this package provides four programs to help you design the garden of your dreams. To begin creating, you can use one of the included templates or scan in a photo of your property, then incorporate plants from the program's huge database into your design.



Graphics are lively and engaging. The interface is intuitive, and first-class help is provided.—Carol Mangis

Complete MasterCook Suite (\$50 street; Sierra On-Line, 800-757-7707, www.sierra.com). Three CDs make up this impressive suite: MasterCook Deluxe, Cooking Light, and Graham Kerr's Swiftly Seasoned. There are thousands of recipes, from the simple and healthy to the exotic and cholesterol-overloaded. The videos are instructional and include some from Graham Kerr's television show. Recipes can be scaled, analyzed for nutritional elements, and sent as e-mail. And don't forget to peruse the included Appetizers & Aperitifs book.—Patricia Perkowski

Cosmopolitan Virtual Makeover (\$39.95 list; Style Pack I, \$19.95; SegaSoft, 888-7342-7638, www.virtualmakeover.com).



Want a styling salon in your own home? This CD-ROM will help you create a new look—from hairstyle to makeup. Import a picture of yourself or a friend with a digital camera or scanner (or use one of the program's models) and get to work. With the new Style Pack I, you get more hairstyles, including a set for African Americans; Luxottica eyewear; and an assortment of hats.—DJ

Creative Photo Albums (\$39.99 list; DogByte Development, 800-936-4298, www.dogbyte.com). A scrapbooker's dream, Creative Photo Albums provides the backgrounds, clip art, borders, and frames. You just print out the pages and add your photos and keepsakes (like that ticket stub from your first date). Even if you're not an arts and crafts maven, you'll be impressed with what you're able to create.—JT

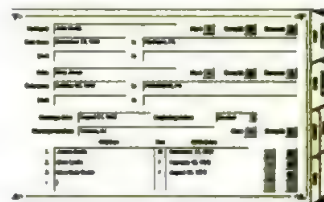
Cyber Patrol 4.0 (\$39.95 list; The Learning Company, 800-622-3390, www.cyberpatrol.com). Cyber Patrol's goal is to protect young eyes and minds from the seedy side of the Internet, and it accomplishes this task admirably. The program contains lists of both objectionable and kid-safe sites, which can be edited by parents. The ChatGard feature blocks kids from divulging their names and phone numbers. The purchase price includes three months of updates.—JT

Greetings Workshop Deluxe (\$45 street; Microsoft Corp., 800-426-9400, www.microsoft.com). Hallmark and Microsoft collaborated on this disk, and the result is a card store in a box. The Greetings Workshop features a cartoon-style interface that gives you access to 12,000 projects (besides cards, you get stationery, posters, and banners). The graphics and messages are pure Hallmark and on a par with those on card-shop cards.—JT

Guitar Method 1 and 2 (each disk, \$60 street; eMedia, 888-256-3311, www.emedia.org). Each of these tutorial disks features more than 60 lessons, starting with the basics of tuning a guitar and working up to playing styles and techniques. Once you learn to strum a tune, you can choose one of the included songs, written by performers like Bob Dylan and Eric Clapton.—JT



Family Tree Maker 5.0 (\$90 street; Broderbund Software, 800-521-6263, www.broderbund.com). Although it's facing some stiff competition, Family Tree Maker remains the top choice for tracking down your far-flung relatives and documenting your family's past. The step-by-step guide provides a starting point for those new to genealogy, and the Social Security Death Index, Marriage



Records Index, and online resources practically guarantee success in tracing your roots. You can display your results using the program's tree and chart templates.—JT

Kai's SuperGoo (\$49.95 list; MetaCreations, 800-846-0111, www.metacreations.com). First there was PowerGoo. Now comes the next step: SuperGoo, which lets you mix and match faces and fea-



tures using Kai's wild but easy-to-use signature interface. In the Goo Room, you can twist, pinch, bulge, smudge, or "goo-plicate" any photo. Then switch over to the effects palette and squeeze, ripple, or spike your photo. Save your images as stills, or better yet, as AVI or QuickTime animations.—Jay Munro

LivePix 2.0 Deluxe (\$49.95 list; The LivePix Co., 800-727-1621, www.livepix.com). With a program as fun and easy to use as LivePix, there's no reason why your next print project shouldn't shine. The program lets you quickly incorporate photos (from a scanner, digital camera, and so on) into one of the hundreds of templates

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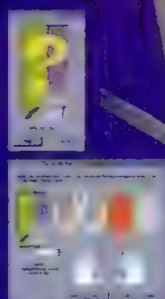
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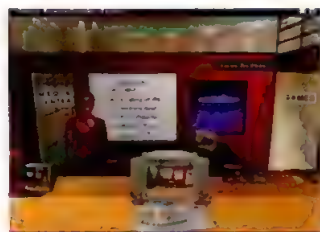
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Mavis Beacon Teaches Typing 8 (\$40 street; Mindscape, 800-234-3088, www.mindscape.com). Mavis, the woman who has taught millions to type, is back for Version 8 of this super-effective tutorial. It has an



inviting interface, with tons of customizable features (from music selection to font type). But it's the clear, well-planned lessons, balanced with fun games and instructional videos, that will have you improving your words-per-minute score in no time at all. —JT

MyTypeArtist (\$20 street; MySoftware Company, 800-325-3508, www.mysoftware.com). Sometimes good old Helvetica or Arial just won't cut it. That's when you need one of the 1,000 typestyles in MyTypeArtist. Formal, hip, funny, or sleek, the fonts are always eye-catching. A helpful interface lets you search by theme, color, pattern, or shape. Your jazzed-up text can be saved in a variety of formats and imported to both Windows and Macintosh applications or posted on the Internet. —JT

Photographer (\$49.95 list; Brighter Paths, 800-333-7367, www.brighterpaths.com). What better way to learn how to take great 35-mm pictures than with a photography simulator? This incredibly helpful program



puts a virtual camera in your hand and lets you select variables such as aperture setting, shutter speed, brightness, and lens type. Then it's on to the video library, where you "shoot" pictures of a wedding, birds in flight, or 21 other scenes. Afterward, the program critiques your work. —JT

Piano Discovery 3.0 (\$49.99 list; Jump! Music, 800-289-5867, www.pianodiscovery.com). Have you had a yen to play the piano since you were a kid but never got around to it? With Piano Discovery and a MIDI keyboard (sold separately), you can embark on the year's worth of lessons included in the program: That's 900 lessons. You'll learn how to read music, play along with a metronome, and master the scales. You'll be playing "Heart and Soul" in no time. —JT

PrintMaster Platinum (\$70 street; Mindscape, 800-234-3088, www.mindscape.com). Lost your dog?

Whip up a poster with PrintMaster Platinum. If you have a scanner, scan Rex's photo right into the poster. Ready-made projects include birthday cards, banners, and calendars. Cartoon-o-Matic, PhotoEnhancer, and the library of 92,000 images let you be creative. —S. Jae Yang



Professor Franklin's Instant Photo Effects (\$40 street; Streetwise Software, 800-743-6765, www.swsoftware.com). Here's another way to have fun with your digital photographs. Professor Franklin's Instant Photo Effects lets you add pizzazz to your photos with a few mouse clicks. From a watercolor to the fun jigsaw-puzzle effect, the choices are numerous. In addition, there are edges, frames, and textures that can be applied to any photo. —S/Y

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3D Home Design Suite (\$80 street; Broderbund Software, 800-521-6263, www.broderbund.com). The real-estate market has been in an uproar lately, which means that many new homeowners are in need of some remodeling help. Featuring 3D Home Architect, 3D Home Interiors, and Imagine Your Landscape, this suite covers all the bases—from designing a new skylight to selecting a paint scheme to planting your rose garden. A well-organized interface and powerful tools highlight this program.—JT

Virtual London '98 (\$39.99 list; Virtual London Ltd., 888-799-1303, www.virtual-london.co.uk). This multimedia London travel guidebook does a great job of organizing and providing tourist information on various sites in London,



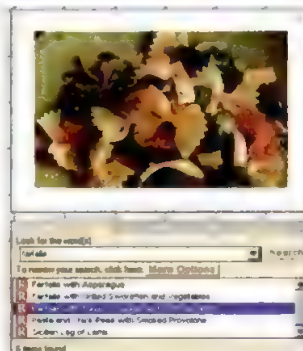
including parks, museums, galleries, churches, and monuments. The easy-to-use interface details information about London's history as well as the more mundane aspects of travel, such as hotels, maps, and currency exchange. You'll savor your London trip, whether virtual or real, with this enjoyable title.—DJ

The Way Things Work, Pinball Science (\$29.95 list; DK Multimedia, 800-467-9580, www.dk.com). Based on David Macaulay's book *The Way Things Work* (and a subsequent CD-ROM), Pinball Science demonstrates the science behind the beloved game. Although the disk is intended for the preteen-to-teenage set, the wonderful animations, descriptions, and pinball games will appeal to arcade buffs of all ages.—JT

What Color is Your Parachute, 1998 Version (\$24.95 list; BumbleBee Technologies, 617-338-1940, www.parachute.net). A job hunter's

bible, this CD-ROM adaptation of the best-selling book offers the strategies of author Richard Nelson Bolles. Through a series of exercises, you'll define your ideal job and working situation. Then the career tools (including Internet sources) will help you land that job.—JT

Weight Watchers Light and Tasty Deluxe (\$40 street; The Learning Company, 800-227-5609, www.learningco.com).



Keeping one of those New Year's resolutions just got easier. This CD-ROM gives you 2,250

recipes from ten best-selling Weight Watchers cookbooks, along with the on-screen Weight Watchers Complete Exercise Book. The 100 videos on cooking technique (everything from Baking Cookies to How to Use a Wok) are a plus. You can create a shopping list, scale recipes, and follow meal plans easily through the friendly interface.—PP

Wines of the World Gold Edition (\$26.95 list; Multimedia 2000, 205-622-5530, www.m-2k.com). Beginning with the grape and progressing to the finished product, Wines of the World details the vinification process and how to select an appropriate wine. That's only a part of the disk, however. There's also a searchable database of over 40,000 wine reviews, with information on wineries, pricing, and vintages.—JT



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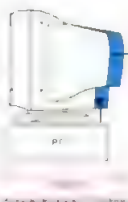
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Horiz. Frequency	30-70 khz	30-70 khz	30-70 khz	30-95 khz	30-95 khz	30-95 khz
Max. Resolution	1280 × 1024	1280 × 1024	1280 × 1024	1600 × 1200	1600 × 1200	1600 × 1200
On-Screen Menus	Yes	Yes	Yes	Yes	Yes	Yes
TCO option	TCO'95	TCO'95	TCO'95	TCO'95	TCO'95	TCO'95
Win.98 ICM profile *	Available	Available	Available	Available	Available	Available

* Windows 98 ICM profile : For display-to-printer WYSIWYG, Windows 98 requires ICM (Image Color Matching) profile for the display monitor. This profile is available free of charge at the place of purchase, or directly from Hyundai.



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AAA Map'n'Go 4.0 (\$40 street; DeLorme, 800-227-1656, www.delorme.com). Furnished with better driving directions than its competitors, this fast, intuitive CD-ROM boasts a truly mammoth list of roadside attractions as well as GPS (Global Positioning System) support. Though the maps are fairly cluttered, you can easily zoom in and out of them. One special feature: Directions can be calculated from door to door, not just from city to city.—*Josh Levy*



The American Heritage Talking Dictionary 5.0 (\$29.95 list; The Learning Company, 800-227-5609, www.learningco.com). In addition to the 200,000-word dictionary (with spoken pronunciations for 90,000 of the words), the integrated thesaurus, and the cultural dictionary, the American Heritage Talking Dictionary has a feature you'll appreciate time and time again: It offers instant access from any Windows-based program. Whether you're using Lotus Notes or Microsoft PowerPoint, you'll never be at a loss for words (or their pronunciations) again.—*JT*

Berlitz Spanish (\$45 street; The Learning Company, 800-227-5609, www.learningco.com). The Berlitz Method of teaching foreign languages has been employed for over 120 years, and after using Berlitz Spanish you'll understand why. The goal here is to become fluent in the language, so instruction focuses not only on speaking but also listening, reading, and grammar.—*JT*

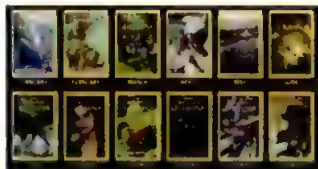
BodyWorks 6.0 (\$45 street; The Learning Company, 800-227-5609, www.learningco.com). Just what makes you tick? From vein to muscle to organ, BodyWorks spells it out—in 3-D. This anatomy tour, complete with photos, 3-D models, and video,

covers over 1,500 topics. Comprehensive search capabilities let you quickly hone in on an area of interest: the brain or skeletal system, perhaps. Web-based updates keep the program's information timely.—*JT*



Britannica CD 98 Multimedia Edition (\$125 list; Encyclopædia Britannica, 800-747-8503, www.eb.com). When it comes to depth and breadth of information, no other encyclopedia quite measures up to Britannica's standards. The new interface—based on Microsoft Internet Explorer—takes a bit of getting used to, but once you master it, you'll be able to track down the entire contents of the 32-volume Encyclopædia Britannica, plus thousands of photos, videos, and Internet links.—*JT*

The Complete National Geographic (\$200 street; Mindscape, 800-881-9919, www.mindscape.com). This 30-disk set represents a complete 108-year run of the magazine that has enlivened geography—not to mention biology, history, and cultural anthropology—with fresh beauty and drama since 1888. It's an endlessly engrossing library: There are over 185,000 colorful pages, excluding only



the audio recordings and "supplemental maps" some issues contained. With remarkable ease you can browse, search, zoom, rotate, print, or link to a Web site.—*Glen Boisseau Becker*

Easy Translator 2.0 (\$49.95 list; Transparent Language, 800-752-1767, www.transparent.com). After a quick search on the Internet, you get to the site that has the information you're looking for—but it's in German

(or French, Italian, or Spanish). Easy Translator 2.0 can quickly translate the page for you. In addition, the program can be used for e-mail or word processor documents. The translations aren't perfect, but it's sure better than relying on your high school German.—*JT*

Encarta 98 Encyclopedia Deluxe Edition (\$60 street; Microsoft Corp., 800-426-9400, www.microsoft.com). An easy-to-use interface combined with a wealth of information and well-integrated multimedia make Microsoft Encarta 98 the choice for your home reference library. It boasts over 32,000 articles, supplemented by a dictionary and a timeline of world history. The disk's strong suit is the engaging interactive multimedia activities, and it also features an impressive online component that includes Web links and downloadable updates.—*Nancy Sirapyan*

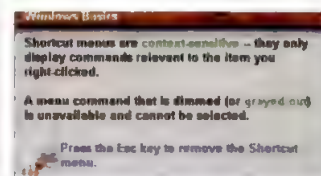
Eyewitness History of the World 2.0 (\$39.95 list; DK Multimedia, 800-467-9580, www.dk.com). Tracing history from earliest human life through 1997, this amazing journal of civilization unfolds through thousands of detailed articles, animations, and maps. Travel through time to the building of the pyramids, the Trojan War, or something as recent as the fall of the Soviet Union. You'll learn how people lived and dressed, and even what they ate. And you'll be immensely entertained and enlightened.—*JT*

Peter Norton PC Guru (\$19.95 list; MediaX, 888-724-8781, www.mediax.com). Using well-planned interactive multimedia, PC Guru helps PC novices easily explore a wide variety of areas related to computing, such as reference, productivity, and games. The complete glos-



sary provides a handy reference. PC Guru also includes Internet connectivity software to get you online quickly and painlessly. Shareware and demo versions of many well-known software products, including Adobe Photoshop and Lotus Organizer, let you try before buying.—*JM*

Professor Teaches Windows 98 (\$19.95 list; Individual Software, 800-822-3522, www.individualsoftware.com). Within the Windows 98 operating system (as well as many applications) are a host of functions and enhancements the average user never employs. Professor Teaches Windows 98 helps you get the most from the OS by introducing topics you



may have overlooked, such as maintaining your system and managing files and folders. Tips, tricks, and shortcuts are also included.—*JT*

Quicken Family Lawyer 99 Deluxe (\$59.95 list; Parsons Technology, 800-644-6344, www.parsonstech.com). Composed of four programs—Quicken Family Lawyer 99, The American Bar Association Family Legal Guide, Quicken Estate Planner, and The Plain-Language Law Dictionary 2.0—this package will help even law neophytes to create legally binding wills, lease agreements, and living trusts.—*JT*

The QuickVerse Multimedia Life Application Bible (\$49 list; Parsons Technology, 800-644-6344, www.parsonstech.com). This CD-ROM provides an easy way to get acquainted (or reacquainted) with the Bible. Explore in whichever manner suits you: Read verse by verse, search for topics, or enjoy the dramatic readings and biblical artwork.—*JT*



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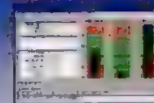
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RedShift 3 (\$49.95 list; Maris/Piranha Interactive, 602-491-0500, www.redshift3.com). RedShift has been a



perennial favorite among astronomy buffs and newcomers alike. The latest

installment of the program continues its winning ways. The new interface makes exploring over 1 million celestial objects even easier. Based on data from NASA and the Russian Space Mission Control Center, RedShift 3 puts the heavens on your desktop. —JT

StreetFinder Deluxe 1998 Edition

(\$44.95 list; Rand McNally New Media, 800-671-5006, www.randmcnally.com). This user-friendly mapping program can pinpoint streets and addresses across the country and show you what's in the neighborhood, from hotels to parks to pizzerias.



Comprehensive and easy to use, it also includes features like map editing and directions for custom walking tours. Combined with a vibrant user interface, it makes a fine travel companion for business or pleasure. —JL

31 Languages of the World (\$40 street; Transparent Language, 800-752-1767, www.transparent.com). Chances are you'll never need to speak 31 different languages, but if you or your family travels a lot, this is a handy package. Whether you're studying Arabic or Thai, the program takes the same, solid approach to teaching: listen, learn, and speak. For each language, there are about 5,000 words and phrases to study. —JT

The Timetables of Technology (\$25 street; Byron Preiss Multimedia, 800-945-3155, www.byronpreiss.com). Get the lowdown on technology through the ages—from the Stone Age to the Information Age—in this

engaging disk. The 3-D navigation bar offers easy access to the seven ages in history, as well as the eight major industries, such as transportation and medical technology. There's also an Internet link for further exploration. —JT

Topo USA (\$99.95 list; DeLorme, 800-227-1656, www.delorme.com).

Attention, all hikers and campers: Topo USA is a must-have, with topographic maps of all 50 states. 2-D renderings give you information on route, elevation, and distance, and the 3-D view gives you a panoramic, flyover experience. The program is GPS-enabled, so you can view the maps on a laptop, PalmPilot, or Windows CE hand-held computer. —JT

TripMaker Deluxe 1998 Edition

(\$44.95 list; Rand McNally New Media, 800-671-5006, www.randmcnally.com). With its easy-to-follow road maps, this trip planner is replete with multimedia tutorials,

GPS features, and lists of hotels and attractions. It even includes Money Minder, to help you keep vacation costs down. Though the routing still isn't perfect, the program is fun to use and reliably points you in the right direction. —JL



Ultimate College Search Guide; **Ultimate College Money Guide** (each package, \$34.95 list; CollegeView Partners, 800-927-8439, www.collegeview.com). Choosing a college is a consequential but daunting task. The Search Guide lists every two-year and four-year school in North America and helps you find schools to meet your needs, and the Money Guide leads you to financial aid. The programs are a breeze to use, with helpful teen avatars that pop up periodically. —CM



Coming Up

What's in the Next Issue of *PC Magazine*

A Preview of Next Year's Software

What will next year's software look like? Will business productivity suites change much? How about utilities and Internet software? Which operating system might you or your company be running next year? How about your e-mail or messaging programs? *PC Magazine* will take a look ahead to let you know what you can expect to see.

Speech Recognition

Most of us who are planted in front of PCs are pretty comfortable with the keyboard for inputting words. Still, some people long for a different way to get their thoughts on the screen. But is speech recognition really there yet? We'll put the latest speech recognition packages through their paces.

Color Flatbed Scanners

The new generation of scanners are more affordable than ever, capable of higher resolutions, and able to scan more kinds of media. And these scanners include more useful bundled software than ever before—not just OCR packages but visual document organizers, too. We'll review the latest scanners to point you in the right direction.



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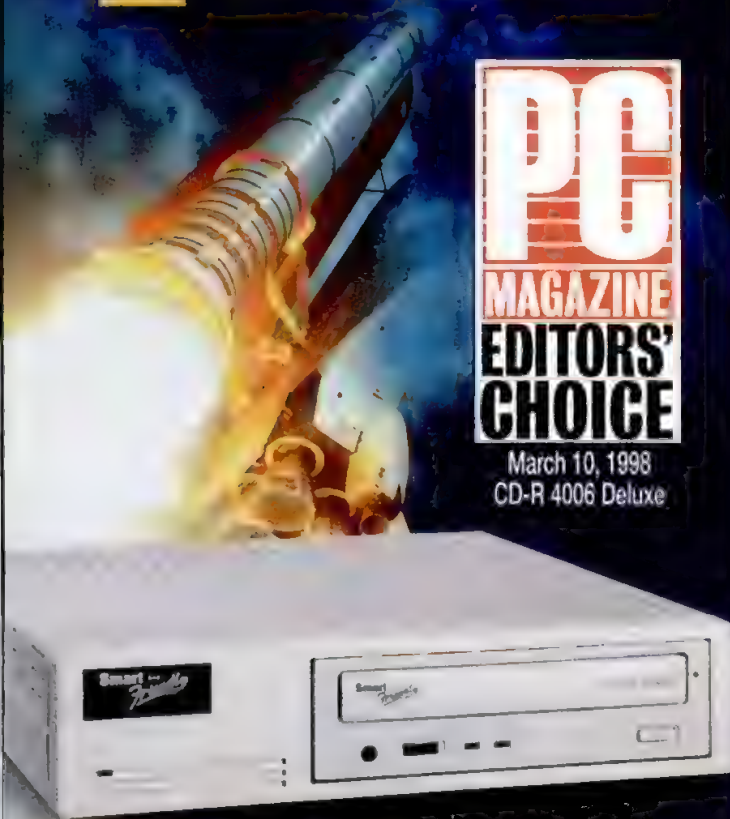
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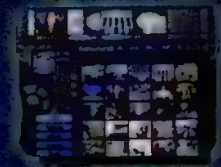
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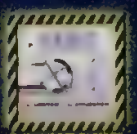
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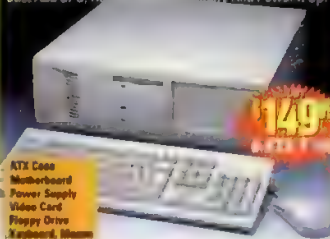
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**FEATURE
BY
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COMPARISON**

FEATURE	HP OMNIBOOK 4100 \$4099⁹⁹	DELL CP1266X \$3167	SOLIS ST \$2479⁹⁹
Processor	Mobile Pentium with MMX or Pentium II.	Mobile Pentium with MMX or Pentium II.	Mobile Pentium with MMX or Pentium II.
Cache	512KB Pipelined Burst Cache.	512KB Pipelined Burst Cache.	512KB Pipelined Burst Cache.
RAM	32MB Standard RAM.	64MB EDO RAM.	64MB EDO RAM.
Display	14.1" or 13.3" 1024 x 768 XGA Active Matrix; with 65,536 colors. Display Bus Architecture: 32-Bit PCI bus video with 128-bit graphics controller; 2MB video RAM.	13.3" 1024 x 768 XGA Active Matrix with 64K colors. 128-bit graphics controller and 2MB EDO video memory.	14.1" or 13.3" 1024 x 768 XGA Active Matrix; with 65,536 colors. Display Bus Architecture: 32-Bit PCI bus video with 128-bit graphics controller; 2MB video RAM.
Hard Drive	2.0, 4.0*, 6.4GB removable Enhanced IDE.	2.1GB, 3.2GB, 4.0GB* or 6.4GB Ultra ATA.	2.0, 4.0*, 6.4GB removable Enhanced IDE.
Module Bay	Accommodates standard FDD, weight-saving module, or CD-ROM drive, optional LS-120 SuperDisk, DVD, second battery.	Accommodates standard FDD, CD-ROM drive, Additional battery.	Accommodates standard FDD, weight-saving module, or CD-ROM drive, optional LS-120 SuperDisk, DVD, second battery.
Floppy Drive	1.44MB, inserts in Module Bay or connects via optional cable.	1.44MB, inserts in Module Bay. Connects with supplied cable.	1.44MB, inserts in Module Bay or connects via optional cable.
CD-ROM	24-max-speed CD-ROM.	20-max-speed CD-ROM.	24-max-speed CD-ROM.
Keyboard	Full-size, 87/88-key with embedded numeric keypad.	Full-size, 87/88-key with embedded numeric keypad.	Full-size, 87/88-key with embedded numeric keypad.
Size	12.9 x 10 x 1.4 inches.	12.8 x 9.49 x 1.74 inches.	12.9 x 10 x 1.4 inches.
Weight	6.6 lbs.; 5.8 lbs. with weight-saving module.	6.4 lbs. with CD-ROM installed.	6.6 lbs.; 5.8 lbs. with weight-saving module.
Ports	USB port, 9-pin serial port, 25-pin bidirectional 25-pin ECP and EEP parallel port; PS/2 keyboard/mouse, 15-pin VGA, line-in, mic-in, speaker-out, 240-pin PCI connector.	USB port, 9-pin serial port, 25-pin bidirectional 25-pin ECP and EEP parallel port; PS/2 keyboard/mouse, 15-pin VGA, line-in, mic-in, speaker-out, 240-pin PCI connector; infrared.	USB port, 9-pin serial port, 25-pin bidirectional 25-pin ECP and EEP parallel port; PS/2 keyboard/mouse, 15-pin VGA, line-in, mic-in, speaker-out, 240-pin PCI connector.
PC Card	One PCMCIA Type III PCI slot or two Type II, Zoomed video support on both slots.	One PCMCIA Type III PCI slot or two Type II, Zoomed video support on both slots.	One PCMCIA Type III PCI slot or two Type II, Zoomed video support on both slots.
Audio	16-Bit SoundBlaster Pro-compatible sound.	16-Bit SoundBlaster Pro-compatible sound.	16-Bit SoundBlaster Pro-compatible sound.
Pointing	Dual; 2-button Touch Pad and pointing stick.	2-button Touch Pad.	2-button Touch Pad.
OS	Pre-loaded Windows 98.	Pre-loaded Windows 95.	Pre-loaded Windows 98.

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SOST-13G1	Intel Pentium 266 MMX	32MB EDO	2.1 GB UDMA	24X	13.3" Active Matrix	\$69	\$1,939.99
SOST-13J	Intel Pentium II 233 MMX	32MB EDO	2.1 GB UDMA	24X	13.3" Active Matrix	\$71	\$1,979.99
SOST-14A1	Intel Pentium II 233 MMX	64MB EDO	2.1 GB UDMA	24X	14.1" Active Matrix	\$77	\$2,149.99
SOST-14D1	Intel Pentium II 266 MMX	64MB EDO	4.0 GB UDMA	24X	14.1" Active Matrix	\$87	\$2,439.99
SOST-14F	Intel Pentium II 266 MMX	96MB EDO	6.4 GB UDMA	24X	14.1" Active Matrix	\$97	\$2,739.99

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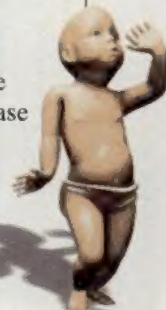
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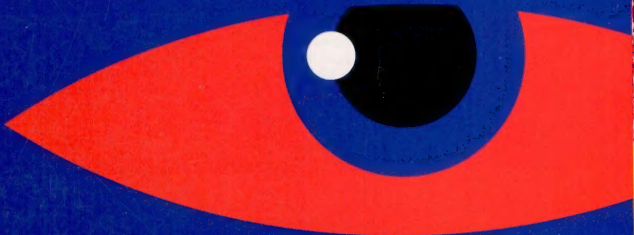
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